BUS. ADM. LIBRARY

NOV 2 1948

The American STATISTI N

The new the

AMERICAN STATISTICA ON

Michigan University,
General Library,
Ann Arbor, Michigan.
A/S
FWF

THE STATISTICIAN
AND EVERYDAY AFFAIRS *editorial* 1
NEWS 2
OPERATIONS RESEARCH—A SCIENTIFIC BASIS
FOR EXECUTIVE DECISIONS *Wm. J. Horvath* 6
DOOMSDAY BOOK FOR SCOTLAND *James Gray Kyd* 9
STATISTICAL GAPS AND ECONOMIC INDICATORS
John W. Lehman 10
THE CENSUS BUREAU TRAINING PROGRAM
FOR FOREIGN STATISTICIANS *Calvert L. Dedrick* 13
WOMEN IN STATISTICS *Marguerite W. Zapoleon* 16
108th ANNUAL MEETING PROGRAM OF THE
AMERICAN STATISTICAL ASSOCIATION 20
QUESTIONS AND ANSWERS *Frederick Mosteller* 30
DISPLAY CHARTS *Edward J. Hegarty* 32
NEWS ABOUT MEMBERS and CHAPTERS 33 and 34

OCTOBER 1948
Volume 2, No. 5

25 CENTS

A SURVEY . . . A NEW TECHNIQUE . . . AND NOMOGRAMS

INTRODUCTION TO MATHEMATICAL STATISTICS

by Professor PAUL G. HOEL, University of California at Los Angeles

"In view of its general excellence, its publication is rather more than just a welcome event: it is the most important happening in the field of undergraduate statistical textbooks in several years . . . Sets an entirely new standard of mathematical and statistical competence for textbooks on intermediate mathematical statistics."—*J. H. CURTISS, Assistant to Director, National Bureau of Standards, in JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION.*

1947 258 pages 35 illus. 23 tables 5 5/8 by 8 5/8 $3.50

CYBERNETICS

or Control and Communication in the Animal and the Machine

by

Prof. NORBERT WIENER, Massachusetts Institute of Technology

Cybernetics is a study of human control functions and of mechanico-electrical systems designed to replace them. As such it impinges on every branch of science in which control or communication has a part. It is the outgrowth of extensive theoretical study and experimentation by Dr. Wiener and a group of outstanding scientists—including physiologists, psychologists, mathematicians, and electrical engineers.

October 1948

$3.00

SEQUENTIAL ANALYSIS

by Professor ABRAHAM WALD, Columbia University

"[This reviewer] was impressed by four facts: (1) The volume of mathematical theory originated by the author, (2) the varied practical uses for this theory, (3) the magnitude and value of the task, and (4) the painstaking effort made to present the material in a logical, thorough, and lucid manner. Dr. Wald is to be congratulated for this contribution."—*F. Z. HARTZELL in JOURNAL OF THE AMERICAN SOCIETY OF AGRONOMY.*

1947 212 pages 16 illus. 7 tables 6 by 9¼ $4.00

NOMOGRAPHY

by Professor ALEXANDER S. LEVENS, University of California

". . . no one in science, engineering, or business should spend too much time on tedious computations if they would give this book a little study. Professor Levens is to be congratulated on the masterful manner in which he has handled the subject. And, too, the publishers should be complimented on the composition of the text matter and the clear representation of the charts and graphs."—*C. E. TOWNSEND, Professor and Head, Engineering Drawing, Cornell University.*

1948 176 pages 88 illus. 29 typical charts 6 by 9¼ $3.00

JOHN WILEY & SONS, Inc., 440 4th Ave., New York 16, N. Y.

The American STATISTICIAN

OCTOBER 1948, Vol. II, No. 5

The news publication of the American Statistical Association

OFFICERS

President: George W. Snedecor
Directors: Isador Lubin, Lowell J. Reed, Walter A. Shewhart, Frederick F. Stephan, Samuel A. Stouffer, Willard L. Thorp
Vice-Presidents: A. Ford Hinrichs, Rensis Likert, Abraham Wald, Harry R. Wellman
Secretary-Treasurer and Managing Editor of Publications: Merrill M. Flood

EDITORS

Editor: Sylvia Castleton Weyl
Editorial Board: Churchill Eisenhart, Samuel P. Hayes, Jr., Lester S. Kellogg, Julius Lieblein, Will Lissner, Marion M. Sandomire, Morris Ullman.
Department Editors:
Questions and Answers
Frederick Mosteller
Presentation Problems
Kenneth W. Haemer
Correspondents: Albany — David M. Schneider; Central New Jersey—Willard C. Thompson; Chicago—Jack R. Green; Cincinnati—Ellery F. Reed; Columbus — Rosemary Tague; Connecticut—J. H. Watkins; Philadelphia—Mary McDermott; New York—Milton Stevens. Government — Virginia T. Venneman. Latin America—Francisco de Abrisqueta. United Nations — F. Marguerite Nowak.

Entered as second class matter March 11, 1938, at the post office at Washington, D. C., under act of March 3, 1897. *The American Statistician* is published six times a year—February, April, June, August, October and December—by the American Statistical Association, Editorial Office: 1603 K Street, N. W., Washington 6, D. C. Subscription rate: one dollar and fifty cents a year or twenty-five cents per copy.

THE STATISTICIAN AND EVERYDAY AFFAIRS

Everyday life is influenced more and more each day by decisions based on quantitative information. The scientific sequence—hypothesis, experiment, and test of hypothesis—is now a familiar approach to problems. Only a few of all those who use it are known popularly as scientists. The distinguishing characteristic of the true scientist is not the fact that he employs scientific method, but is rather his expertness with it.

So it is with the statistician. Nearly everyone, scientists included, draws conclusions from quantitative data. A mark of the true statistician is his special expertness at arranging an investigation and analyzing the results so as to yield the most reliable conclusions with minimum effort.

The statistician has something important to contribute toward the solution of problems of *every* kind met in everyday life. He therefore has a special opportunity for the development and widespread promotion of scientific method in general and an added responsibility for statistics.

The Association has throughout its history played an effective role in governmental affairs. A notable example is the work some years ago of the Committee on Government Statistics and Information Services that led to the formation of the Central Statistical Board—since succeeded by the Division of Statistical Standards of the Bureau of the Budget. With minor exceptions, formal participation of the Association in public activities has been limited to problems in economics and other social sciences.

The newly formed Commission on Statistical Standards and Organization, announced in this issue of *The American Statistician*, represents another important step forward in the Association's program for more widespread use of statistics. The Commission can draw on the human resources of the Association for subcommissions uniquely qualified to review any matter from the statistical standpoint. The broad variety of skills within the membership will enable the Commission to select the most important among a wide range of problems. It is safe to predict that the Commission will usually face very broad problems—problems whose solutions can be found only by a working team of statisticians with widely varied backgrounds in science and everyday affairs.

Were the Commission to appraise the statistical basis of the Kinsey report, for example, a just effort might require the combined talents of biologists, sociologists, psychologists, educators, and specialists in sampling method and interviewing techniques. Or were the Commission to accept a request for advice concerning the principles that should guide the Federal Government in its release or classification of statistical information, as a national security measure, it might establish a subcommission composed of economists, psychologists, military strategists, engineers, and other specialists with expertness in statistical method. It is an impressive fact that the Association can provide staffs for subcommissions of such broad competence from its own present membership.

The general public is not technically competent to evaluate the statistical methods used in coping with such problems. If the people are to retain confidence in the validity of scientific statistical method and the integrity of professional statisticians, then it is clearly desirable that the Association take a larger measure of responsibility in maintaining professional standards. The Commission on Statistical Standards and Organization is one of the means by which public confidence in statistical analysis will be preserved and fortified. It will be a powerful aid in assuring that statistics remains a method for discovering truth, rather than entrenching error.

THE EDITORS

NEWS

Commission on Statistical Standards and Organization appointed—Vital statistics round table—Productivity conference—Universities enlarge statistics programs—Army personnel requirements—New publications

Commission on Statistical Standards and Organization Appointed

George W. Snedecor, President of the ASA announces the appointment by the Board of Directors of a Commission on Statistical Standards and Organization. Members of the Commission are: S. S. Wilks, Lowell J. Reed (1 year); Isador Lubin, *Chairman*, Frank W. Notestein (2 years); Frederick E. Croxton, Walter A. Shewhart (3 years).

The announced functions of the Commission are: To provide a tribunal to render opinions and recommendations on controversial issues relating to statistical procedure and presentation of statistical material. To develop a list of minimum standards for published statistical materials. Upon request from governmental bodies, review actual or proposed undertakings and make recommendations relative to standards.

Professor Snedecor expressed the hope that the Commission may become a powerful instrument for the improvement of the standards of the statistical work of the country and that it would be the medium of contact between the Association and organizations using statistics, especially those in the public service. Members of the Association are expected to take the initiative in proposing matters for the consideration of the Commission.

Vital Statistics meeting in Boston Nov. 10

The Eastern North American Region of the Biometric Society will hold a joint session with the Vital Statistics Section of the American Public Health Association at the annual meeting of the Association, on Wednesday, November 10 at 9:30 A.M. in the Paul Revere Banquet Hall, Mechanics Building, Boston, Massachusetts.

A round table, with the following participants will be followed by a general discussion.

Moderator: George St. J. Perrott, Chief, Division of Public Health Methods, U.S. Public Health Service.

Public health statistician: Theodore D. Woolsey, Division of Public Health Methods, U.S. Public Health Service

Sampling statistician: Nathan Keyfitz, Mathematical Advisor, Dominion Bureau of Statistics, Ottawa, Canada

Opinion poll statistician: George Gallup, Director, American Institute of Public Opinion, Princeton, New Jersey

Epidemiologist: Alexander D. Langmuir, Associate Professor, Department of Epidemiology, School of Hygiene and Public Health, Johns Hopkins University.

Health officer: Huntington Williams, Commissioner of Health, City of Baltimore.

Givens to work on accident statistics

Meredith B. Givens, of the New York Department of Labor, has been appointed the representative of the American Statistical Association on the Z16 Committee of the American Standards Association.

The Committee is sponsored by the American Standards Association, the National Safety Council, the National Council on Compensation Insurance and the International Association of Industrial Accident Boards and Commissions. It is concerned with national standardization of the definition of various classes of disabilities; time charges assigned to disabilities; definitions of frequency and severity rates; and general rules for the compilation of rate statistics.

Scientific personnel needed by Army Ballistic Research Laboratories

Additions are currently being made to the scientific staff of the Ballistic Research Laboratories, and vacancies exist in the professional grades for mathematicians, physicists, aerodynamicists, statisticians, chemists, electrical and electronic engineers.

In these days of rapid advances in all fields of the physical sciences, it is necessary that the Armed Forces maintain some first-rate scientific organizations to insure that scientific advances in fields peculiar to national security keep pace with advances in the allied formal fields of science. The Army has such an organization in the Ballistic Research Laboratories located at Aberdeen Proving Ground, Maryland. Here, guided by an advisory group of internationally known leaders in the related physical sciences, scientific principles and methods are applied to produce new and important contributions to ballistics. The Laboratories conduct basic research in the relevant branches of mathematics, physics, aerodynamics, chemistry, and engineering and have become one of the world's most important sources of ballistic knowledge.

Among the better known research facilities at these well equipped Laboratories are the two supersonic wind tunnels which make it possible to do experimental research and testing at air speeds up to Mach No. 4; the ENIAC (the world's fastest computing machine and the first practical electronic computer) and two relay computers which help make up the world's best equipped, most powerful computing laboratory; a free flight aerodynamics range for research and for testing guided missile models and other aerodynamic configurations; high speed flash X-ray equipment (flashes of less than one tenth microsecond duration) for investigating

phenomena such as detonation; long-range tracking telescopes (astronomical types up to 16 in. reflectors), radio doppler and radar devices for tracking missiles and telemetering for studying full-scale guided missiles in flight; ultrasonic, micro-wave and spectrographic equipment.

Exceptional latitude is allowed for choice of work; there is ample freedom for research, and initiative is encouraged. Scientists interested in the challenging opportunities offered in the fields of research currently being pursued at the Ballistic Research Laboratories should communicate with Colonel Leslie E. Simon, Director, Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland.

Conference on productivity

The second general meeting of the Conference on Productivity was held on June 10 in the Departmental Auditorium, Washington, D.C. The participants were drawn from labor, industry, universities, and public and private research agencies. Dr. Frederic Dewhurst, of The Twentieth Century Fund, acted as chairman of the three sessions of the Conference. Dr. Hiram S. Davis, Wharton School of Finance and Commerce, University of Pennsylvania, was guest speaker at the evening dinner session.

The Conference on Productivity is planned as a technical forum for the discussion of productivity concepts and measurements, the current state of knowledge concerning productivity, the adequacy of existing research programs, and related questions. The Conference is sponsored by the U.S. Bureau of Labor Statistics and the Division of Statistical Standards, Bureau of the Budget. It is a permanent organization and, in addition to general meetings such as this one, conducts round table meetings for the discussion of technical subjects.

The June 10 sessions were primarily discussion meetings covering recent trends in productivity in the American economy. The papers presented covered such topics as trends in the relation between gross national product and employment, trends in productivity in agriculture, bituminous coal mining, anthracite mining, nonferrous metal mining, light and power, communications, steam railroad transportation, and in those manufacturing industries for which data are available. The results of a survey on productivity conducted by the National Industrial Conference Board were presented.

CORRECTION

Senior Membership in the Association. The Constitution of the Association, still in effect, was quoted incorrectly in the August issue of The American Statistician. It should have read "Regular Members and Fellows who have been members for 35 years, or who have reached the age of 65 years and have been members for 25 years, shall be exempt from the payment of annual dues."

American Standards Association incorporates

The American Standards Association has announced that it became the American Standards Association, Inc. on August 2, through incorporation under the laws of the state of New York. Organized in 1918 as the American Engineering Standards Committee, a coordinating committee for the standardization work of five of the country's important technical societies, the scope of the committee was soon broadened to include associations and government agencies. In 1928 the committee was reorganized into the American Standards Association, the nation's clearing house for standards and the U.S. medium for international contacts on standardization.

The Association's coordinating functions now extend to standards in the mechanical, electrical, building, photographic, mining, safety, and consumer's goods fields, as well as such general work as that of office equipment and abbreviations, and symbols for use in engineering and scientific literature.

Statistical recommendations of the Inter-American Council of Commerce and Production

The Inter-American Council of Commerce and Production has published a series of pamphlets containing the recommendations and resolutions approved by it. Pamphlet No. 41, which deals with statistical subjects, has four recommendations: on uniform methodology, studies of the economic situation, determination of national income, and the 1950 census.

The Council recommends that its members collaborate in the preparation of statistics on production and consumption, to aid in correcting the present deficiencies in the statistics of foreign trade, and to help in the organization of uniform statistics of transportation and mail service.

The Council also expressed its support of every effort to make Latin American statistics conform to accepted Inter-American standards and to encourage the collection of basic data in accordance with the standards established by the InterAmercan Statistical Institute. It recommended that the InterAmerican Statistical Institute reactivate its project for a convertibility index of equivalents of foreign trade nomenclature in the American nations.

In discussing studies of the economic situation, the Council recommended that its members support, both economically and otherwise, the establishment of permanent organizations for the periodic study of national or regional economic conditions, preferably under the auspices of some scientific group of recognized authority (such as university institutes for economic research, national statistical societies, etc.). The Council also recommended that the InterAmerican Statistical Institute, in developing its preliminary research in the economic field, establish a standard plan for economic studies, including a minimum list of the most significant statistical series for this purpose, specifying their most essential methodological characteristics for the purpose of promoting uniformity in the national studies and indicating to the National Statistical Services those series of data which are most essential.

It is with deep regret that the American Statistical Association reports the death of John H. Watkins. Professor Watkins was a major support of Statistics at Yale University. He was Secretary of the Biometrics Section of the ASA; Secretary of the Eastern North American Region of the Biometric Society and of the Connecticut Chapter of the American Statistical Association. His loss will be felt very greatly.

Recent appointments and promotions in the Statistical Laboratory, University of California

Dr. Edward W. Barankin was promoted to Assistant Professor and Research Associate at the Statistical Laboratory, University of California, Berkeley.

Dr. Joseph L. Hodges, Jr. has been promoted to Instructor and Research Associate at the Statistical Laboratory, University of California, Berkeley.

Dr. Michel Loeve, Reader in Mathematics, Kirkwood College, University of London, has been appointed Professor of Mathematics and Research Associate in the Statistical Laboratory, University of California, Berkeley.

Miss Edith Mourier, Research Assistant at the Institut Henri Poincaré, Paris, France, has been appointed Research Assistant and Teaching Assistant at the Statistical Laboratory, University of California, Berkeley.

Mr. David Rubinstein, Junior Research Assistant in the Statistical Laboratory, University of California, Berkeley, has been promoted to Teaching Assistant.

Miss Elizabeth L. Scott, Associate and Research Assistant in the Statistical Laboratory, University of California, Berkeley, has been promoted to Lecturer and Research Assistant.

Dr. Charles M. Stein, Instructor and Research Associate, in the Statistical Laboratory, University of California, Berkeley, has been promoted to Assistant Professor and Research Associate.

University of Chicago expands statistics program

The School of Business of the University of Chicago has announced an expansion of its evening program in statistics at the Downtown Center. Beginning in the Autumn Quarter 1948, a full program of advanced as well as introductory courses in statistical methods will be offered. There will be a series of courses about statistical conferences and sampling inspection. Details may be obtained from the University College, The University of Chicago, 19 South LaSalle Street, Chicago 3, Illinois.

The Philosophy of Science Association

The Philosophy of Science Association has been reorganized with Philipp Frank of Harvard University as President; C. West Churchman of Wayne University, Detroit, as Secretary-Treasurer.

The following are members of the Governing Committee: Gustav Bergmann, State University of Iowa; Thomas A. Cowan, Wayne University; Clyde Kluckhohn, Harvard University; Sebastian Littauer, Columbia University; F. S. C. Northrop, Yale University.

The official journal of the Association is the *Philosophy of Science* of which Professor C. West Churchman is Acting Editor. All inquiries should be addressed to Professor Churchman, at Wayne University, Detroit, Michigan.

Psychometric fellowships awarded at Princeton

The Educational Testing Service, Princeton, N. J., is offering for 1949-50 its second series of research fellowships in psychometrics leading to the Ph.D. degree at Princeton University. Open to men who are acceptable to the Graduate School of the University, the two fellowships carry a stipend of $2,200 a year and are normally renewable.

Fellows will be engaged in part-time research in the general area of psychological measurement at the offices of the Educational Testing Service and will, in addition, carry a normal program of studies in the Graduate School. Competence in mathematics and psychology is a prerequisite for obtaining these fellowships. Information and application blanks may be otained from: Director of Psychometric Fellowship Program, Educational Testing Service, Box 592, Princeton, N. J.

Stanford University establishes new department of statistics

Dr. Alvin C. Eurich, Acting President of Stanford University, has announced the creation of a new department of statistics to meet the growing need for competent statisticians in government, the universities, and industry. The new department will give training in statistics at both graduate and undergraduate levels. It will do research in statistical theory and techniques and consult on statistical aspects of university research. Students will work in pure mathematics, mathematical statistics, and fields in which statistical methods can be applied. The present courses being given in statistics are to be incorporated in the new department.

Albert H. Bowker, Assistant Professor of Mathematical Statistics at Stanford, will be acting head of the department. Meyer A. Girshick of Project Rand has been appointed Professor of Statistics in the department, and Stanford faculty members whose work already includes special applications of statistics will cooperate with the new department in instruction and research. They include Eugene L. Grant, Quinn McNemar, George Polya, Willis H. Rich, Paul B. Simpson, Holbrook Working, William A. Spurr, and Frank W. Weymouth.

FAO issues monthly bulletin

The first issue of *Food and Agricultural Statistics*, a new monthly bulletin of the Food and Agriculture Organization of the United Nations, was published July 1948. This bulletin, appearing in French and English, contains regular statistical series on production (grains, fibers, meat, and dairy products), trade (grains and copra) and prices (grains, meat, and fibers), plus indexes of prices to agricultural producers, wholesale agricultural prices and retail food costs. The data are from official sources, where available, with some unofficial estimates. The maximum coverage is about 50 countries with the U.S.S.R., as usual, not available. The publication contains about eight pages of notes, covering agricultural developments, bulk purchase arrangements, crop forecasts, etc. The price is 25c per issue and may be obtained from the Food and Agriculture Organization, 1201 Connecticut Avenue, N.W., Washington, D.C.

Coordination of United Nations statistical work

Coordination of statistical work in the United Nations is cited as an example of the coordination of UN economic and social activities that should be achieved in a survey of the problem by the Carnegie Endowment for International Peace.

"The United Nations and the specialized agencies have agreed to coordinate their statistical services, not only in order to improve their general usefulness, but to avoid as far as possible overlapping and duplicatory requests for data from national governments," the survey says.

"Surprisingly enough, in view of the experience in large national administrations, statistical coordination appears to be progressing with good effect.

"An example of this type of coordination may be cited. *The United Nations Monthly Bulletin of Statistics* and the (International Monetary) Fund's *International Financial Statistics* have been jointly planned. The responsibility for collection and elaboration of various types of data has been divided between the two institutions and the presentation of the data in the two bulletins has been planned to maximize their total usefulness.

"The work of the Statistical Commission and the Consultative Committee on Statistical Matters, to date, is impressive. Besides serving as a useful medium for the periodic exchange of expert knowledge on means of applying and improving statistical techniques at the international level, the latter Committee has been instrumental in allocating responsibility agency-wise for the collection and analysis of statistical data on such subjects as transport and national income.

"It has adopted a proposal that international agencies should use 1937 as the pre-war base in their publication of index numbers (except for agricultural production). Further, it has induced the United Nations and the functional agencies to agree to exchange statistical questionnaires after issuance so that each agency may be fully advised about the request for statistics which are being directed to national governments. In this connection, the Statistical Office in the United Nations secretariat is serving as the collection and distribution channel.

"The Statistical Commission of the Economic and Social Council, while recommending this arrangement as a first step, has urged that it provide, wherever practicable, for the circulation of questionnaires for comment prior to issuance. More recently, the Consultative Committee has tackled the problem of how to standardize systems of numeration in census-taking and the terminology of currency units."

Remarking that "these developments are already bringing results," the survey goes on to cite examples in which the International Monetary Fund, the UN Department of Economic Affairs and the secretariat of the interim commission of the World Health Organization figure.

The survey, entitled "Coordination of Economic and Social Activities," was conducted by Dr. Walter R. Sharp, chairman of the department of government at the College of the City of New York, in collaboration with the Carnegie Endowment staff. The second of the Endowment's series of United Nations Studies, it can be obtained for 25 cents from the Endowment, 405 West 117th Street, New York 27.

Supplement to UN "Monthly Bulletin of Statistics"

The Statistical Office of the United Nations has published the first issue of the Supplement to the "Monthly Bulletin of Statistics." The purpose of the Supplement is to provide more detailed definitions and explanatory notes for the statistical series published in the Bulletin than is possible in footnotes to the tables. The definitions and notes cover more than 1,500 statistical series from over 60 countries. Particular reference is made to scope, coverage, methods of compilation, definitions, limitations, and other factors affecting international comparability of statistics.

The explanatory Supplement is being distributed to all subscribers to the "Monthly Bulletin of Statistics." Additional copies may also be purchased, at $1.50 a copy, from the International Documents Service, Columbia University Press, 2960 Broadway, New York 27, New York.

Washington, D. C. Police Department installs new crime reporting system

Paul Wiers of the Federal Bureau of the Budget, in his article, "Criminal Comparisons", which appeared in the June *American Statistician*, writes that Washington, D. C., had a thriving crime wave last spring—on paper, after the city had enjoyed a past reputation—again on paper—for a normal crime rate among cities of comparable size. Mr. Wiers points out that although there may have been a change in the trend of crime in Washington during early 1947, its direction and extent were obscured by changes in methods of reporting used by the police.

Crime reporting in Washington will now be much more accurate and reliable as a result of the recent installation by IBM of a completely up-to-date code index system to be handled by the central communications and records bureau of the Police Department. The new system is modeled on the uniform crime reporting procedure indorsed by the FBI and the International Association of Chiefs of Police.

CONTINUED ON PAGE 29

Operations Research—A Scientific Basis for Executive Decisions

by WILLIAM J. HORVATH Operations Evaluation Group
Office of the Chief of Naval Operations

Historical origin

The past war has witnessed an unprecedented concentration of scientific effort on military problems. Scientists in every field were called upon to develop new and improved devices to make our military forces more effective. However, the introduction of the large amount of new equipment developed by the laboratories presented the military with the very difficult task of developing the tactics to put them to their most effective use. Normally this would require a long period of trial and error but time and the enemy did not permit any such delay. Accordingly the assistance of scientists, who were already familiar with the technical performance of the equipment, was sought for the solution of this problem. The advice of these scientists was found so useful that regular groups were organized in a number of military headquarters to subject all military operations to careful scientific analysis. This activity came to be known as "operations research," a new application of scientific method which appears to have great potential value in many fields other than those of a purely military nature.

Like many of our wartime discoveries, operations research was British in origin. The first group of scientists to undertake the study of operational problems was assigned to the Headquarters of the Royal Air Force Fighter Command a few days prior to the outbreak of the second world war. The success of this first operations research section lead to the establishment of similar groups in the other R.A.F. Commands, a sizeable group at the Admiralty, and smaller groups at many British Army Operational Headquarters. By the end of 1942 several American groups, including the Anti-Submarine Warfare Operations Research Group and the Mine Warfare Operations Research Group had been established and from then on the development of the subject was a joint allied activity with important contributions by both sides.

Basic concepts of scientific staff work

Any discussion of the nature of operations research and its value in the study of the non-military problems that occur in the workings of a modern society must suffer somewhat from the fact that one has to describe an abstract idea rather than a spectacular new development such as atomic energy which has many physical manifestations. And yet this idea—that the scientific method be applied to the study of complex human operations—is as important to the continued economic and social improvement of a technological society as any single physical discovery. The methods used in these studies are not new—they are those which have been used for generations by trained scientists in studying the laws of nature. Despite this, the results achieved by the groups adapting these well-tried methods to the evaluation and improvement of military operations were in some cases so impressive that public acknowledgement of the effectiveness of their work was given by the military commanders at the end of hostilities.*

Since a military operation is only one of many possible types of operations engaged in by modern societies, the techniques which were used so successfully to increase the effectiveness of our military organizations may be used equally well for the study and improvement of other operations such as manufacturing, distribution, communication, transportation, farming and, in fact, the operation of any large organization which performs some repetitive process that can be expressed in quantitative terms. Why is it then that such a powerful tool for the improvement of society should first have been put to use in the field of warfare? The answer to this question will help define operations research and clarify the relationship of the people engaged in this work to the organization which they serve.

The most succinct statement of the function of an operations research group is that it provides the administrator or executive department with a quantitative basis for decision. The importance to an administrator of having a small group, under his direct control, capable of evaluating the effectiveness of particular plans of action by thorough scientific methods is obvious to anyone who has been faced with deciding between alternative plans.

* Fleet Admiral Ernest J. King, in his final report to the President, says in part ". . . The late war, more than any other, has involved the interplay of new technical measures and opposing countermeasures. In this see-saw of techniques the side which countered quickly, before the opponent had time to perfect the new tactics and weapons, had a decided advantage. Operations research, bringing scientists in to analyze the technical import of the fluctuations between measure and countermeasure, made it possible to speed up our reaction rate in several critical cases . . ."

The personnel of such a group must, of course, possess an intimate knowledge of the workings of the organization as well as a good background in scientific method. For, in order to analyze a particular operation, the analyst must be familiar with the smallest details involved but at the same time have the ability to look upon that operation as only a part of the whole general system under consideration. He must be able to place himself in the position of those charged with actually carrying out the operation and yet preserve a certain disinterestedness which prevents him from focussing his attention on some highly specialized component of the operation and thereby overlooking other features which may be less technical but contribute more heavily to the final outcome. This dual requirement of complete knowledge of the problem at the "grass-roots" and the ability to put together the many specialized pieces into an integrated whole, places the operations research worker in a unique position in any organization. His function must be entirely advisory and be free of all executive responsibility and yet he must have access to the highest executive levels. Furthermore, and this epitomizes the work of an operations research analyst, since the results of his studies will be the basis of executive decisions, they must be expressed in terms of action rather than scientific principles. Each course of action will need its supporting arguments with the assumptions and deductions clearly set forth but it must be kept in mind that the scientific method is used only to ensure the correctness of the decision and not to impress the executive.

The generalization of the staff system to private industry and government departments

With this background the reason for the sudden growth of operations research in the military field becomes clear, for the type of administrative organization needed to put operations research into effective use is one which had been developed by the military services to maintain the flexibility of the huge organizations which they controlled. It was found necessary to provide the command echelon with a staff for the preparation of orders, gathering of intelligence, and conception of plans and policies. The staff consisted of men qualified to command but relieved of all administrative duties and allowed to devote full time to the study of the basic problems contributing to military decisions. The staff system could easily be modified to include scientists for the more detailed quantitative evaluation of particular plans of action. On the other hand, in a bureau system such as those employed by most government departments and large industrial organizations, the specialist is used purely in an advisory position where he is given little chance to form an integrated picture of the problem beyond the application of his own specialty. It is only when a group of such specialists without particular loyalties to any one bureau are assembled as a staff under the chief executive that they are able to study the functional relations which appear in the operation of the organization as a whole. It is this type of study which contributes most toward the improvement of an organization, not the advice of an isolated technical specialist.

It may seem at first sight that any system evolved under military auspices would lead to a certain amount of regimentation and to the suppression of initiative which, in the popular mind, is connected with military organizations. However, the staff system as described above is a purely administrative procedure and has nothing to do with questions of military discipline and restriction of personal freedom. In fact the staff structure can be used under any political system which allows freedom of investigation and a free expression of ideas on the part of the analyst. The necessity for this freedom of investigation is due to the fact that the staff must not only solve problems put to it by the executive but also make studies and suggestions on its own initiative. Without this two way flow of ideas the staff would be only partially effective since in a complex situation the administrator may not be able to isolate the problem completely and the staff may be put to work on a problem whose solution will not remedy the situation in question. This is one of the principal reasons for requiring an operations analyst to have a good scientific training. A person with a background of scientific research is much more likely to have the structural insight necessary to define the problems which should be solved to increase the effectiveness of an organization. This philosophy was generally accepted by the military during the past war and operational research scientists were, by and large, given complete freedom to initiate any studies they saw fit. This does not imply that their conclusions, however accurate and carefully documented, were always put into action. It must be realized that in any administrative decision, military or otherwise, there are always a number of considerations which cannot be put into quantitative terms. Knowledge of these qualitative aspects and the decision to use them are the proper function of the administrator and are not the job of the operations analyst.

The sole function of the operations research staff is to increase the understanding of the administrator as to the implications of the decisions which he may make. In this respect operations research is more in the nature of an ecological study—its purpose is to understand more fully the operation of the organization as a whole and the interaction of its component parts. However, it should be emphasized that only those organizations (or parts of organizations) which perform repetitive operations can

be successfully studied in this way. It is absurd, for example, to suggest as some people have done, that operations research be used to optimize the basic research programs of laboratories. The only contribution that operations research can make toward the running of laboratories is to study the operation of laboratory services such as stockrooms, libraries, technicians and shops so as to conserve the time of scientific personnel for the more important tasks in research work.

The Analyst must adhere strictly to scientific principles

We have stressed the need for an adequate scientific training for persons engaged in operations research work. This does not mean that we can take scientists directly from their laboratory or computing machine and expect them to be immediately useful in the solution of operational problems. Not only must the scientist familiarize himself with the detailed workings of the organization that he is studying but in many cases he must develop a broader understanding of scientific principles. It is an unfortunate fact that specialization in science has been carried to a point where most research scientists concentrate their activities entirely on their special problems to such an extent that they lose sight of the basic principles involved in the use of the scientific method. There are very few scientists who have preserved a sufficient feeling of the wholeness of science and the scientific method to be immediately useful in operations research work. In extending the scientific method to the study of the operation of large organizations, the practising scientist must be made conscious of those principles which he instinctively applies in his own research. Every good research scientist is trained first, to reject unsupported statements and put all arguments on a quantitative basis and secondly to look for some causal relationships in the phenomena that he observes. The goal of all operations research is the prediction of the effect of certain untried actions but before this can be achieved the analyst must proceed through several stages to the understanding of the problem. There is first, the collection of data relevant to the problem under study, second, a study of the data to determine the inter-relationships of the variables, thirdly the formation of a theory to explain these relationships and finally the use of the theory to make predictions for future use. It is the third step which the natural scientists will find most difficult to apply in operational studies. In the natural sciences, broad theories for the behavior of matter already exist and it is to these that the average scientist turns for the explanation of his findings. However, these theories taken by themselves throw no light on operational problems and the scientist must rely on his structural insight to produce an explanation for his findings. The complexity of human operations is such as to make this a very difficult task. Nevertheless, experience with military operations has made significant advances toward a better understanding of these problems and a discussion of them would prove profitable.

The methodology in military operations

Modern wars are characterized by extreme mobility and continuity of operation that has been made possible by complete mechanization and the mobilization of huge industrial resources to employ against the enemy. The continuity of the operation enables the analyst to formulate a mathematical description of the process and set up quantitative measures of the effectiveness of the operation. This point of view is well illustrated by the submarine war against merchant shipping where the action is no longer considered as a series of isolated engagements but a continuous attrition in the flow of shipping caused by the enemy submarine fleet. Thus it becomes possible to keep a continuous quantitative measure of the effectiveness of the enemy by keeping a record of ships lost per U-boat month at sea. Similarly, from the defensive point of view, the effectiveness of aircraft patrols can be measured by U-boat sightings per mile flown. These measures of effectiveness are quite sensitive to a change in tactics or the introduction of new equipment by either side and any significant change noted from month to month should be subjected to very careful examination as to possible causes. This phase of the work involves merely the keeping of accurate statistics on operations and the ability to recognize significant changes on top of the normal fluctuations. Despite the simplicity of this procedure, its use during the war led to several very important deductions on the strength and tactics of the enemy which were afterwards corroborated by other evidence. Since the military commanders rely heavily on their intelligence systems to furnish information on the strength and capabilities of the enemy, they understood at once the importance of continuous accumulation and analysis of operational data. The military operations of World War II were probably the most carefully documented of any comparable large scale operation and these records were a valuable source of material for the operations research worker.

Preliminary studies of these data revealed the rather remarkable fact that certain operational quantities remained practically constant even when figures were compared for different theatres of war. For example, it was found that the number of mines laid per ship sunk in an aircraft mining campaign was about the same for

CONTINUED ON PAGE 18

Doomsday Book for Scotland

by JAMES GRAY KYD, C. B. E.
Registrar General for Scotland

Scotland has a more precise knowledge of the way of life of her people in bygone days than any other country of the world. This knowledge has been gained very largely from the intimate details of life in individual parishes recorded in the two Statistical Accounts of Scotland. A third Account has now been started and teams of investigators are at work compiling material for four preliminary volumes.

The first Statistical Account, started in 1791, was the work of one man, Sir John Sinclair, Baronet, of Ulster, a former President of the Board of Agriculture of Great Britain.

He introduced the word "statistical" into the English language, but the meaning which he attached to it was something much more simple than the present rather somber idea of statistics. Sir John's object was to find out "the state of the country, for the purpose of ascertaining the quantum of happiness enjoyed by its inhabitants and the means of its future improvement."

Scotland is divided into 33 counties, each composed of a large number of parishes; there are approximately 850 of these in the whole country. Sir John sent out a Schedule of nearly 200 questions to every Parish Minister requesting each one to write an Account of his own parish embracing the various points brought out in the questionnaire. The work took seven years to complete. The resulting intimate details of every parish have been of the greatest use to Scottish historians, economists and planners.

Sir John gave the profits from the sale of his Statistical Account to the Society for the Sons and Daughters of the Clergy of the Church of Scotland. This Society undertook a Second or New Statistical Account between the years 1834 and 1845 on almost identical lines to those adopted by Sinclair.

Considerable advances in transport and in the way of life generally had been made by the time the New Account was written, and a comparison of the descriptions of individual parishes in the two Accounts shows the progress made in Scotland during the first 40 years of the last century.

Sir John Sinclair's project met with great appreciation from every part of the globe. George Washington, in a letter dated 15th March 1793, shows how this enterprise was received in America:

> "I cannot but express myself highly pleased with the undertaking in which you are engaged (that of drawing up the Statistical Account of Scotland), and give my best wishes for its success. I am full persuaded, that when enlightened men, will take the trouble to examine so minutely into the state of society, as your inquiries seem to go, it must result in greatly ameliorating the condition of the people, promoting the interests of civil society, and the happiness of mankind at large. These are objects truly worthy the attention of a great mind and every friend to the human race, must readily lend his aid towards their accomplishment."

The vast changes which have taken place during the century since the Second Account was completed, in the way of life of the Scottish people and in the development of industry and agriculture have never been adequately recorded.

Some years ago a movement was started to inaugurate the taking of a Third Statistical Account of Scotland. The suggestion was first made at a meeting of the Royal Philosophical Society of Glasgow in the autumn of 1944, and met with immediate support from the country. The Scottish Council of Social Service appointed a Sub-Committee, which outlined the organization necessary if the survey were to be undertaken.

Through the generosity of the Nuffield Foundation a start has been made and four "Pilot" volumes are now being compiled. The four Scottish Universities have become responsible for supervising surveys within their own areas. In the counties of Ayr, East Lothian and Fife, surveys are being respectively controlled by the Universities of Glasgow, Edinburgh and St. Andrews, while the University of Aberdeen is controlling a survey of that city. Each University has appointed a Survey Officer to interest the people of the local parishes and to guide them in the preparation of reports of life in their own area.

Sinclair depended entirely on the local parish ministers for the accounts of the individual parishes. While we have been assured of the willing cooperation of the

CONTINUED ON PAGE 15

Statistical Gaps and Economic Indicators

by JOHN W. LEHMAN
Clerk, Joint Committee on the Economic Report, U. S. Congress

One of the important problems and real opportunities facing the statistician today is that of evaluating and improving the basic tools which legislators and administrators need and use in shaping public policies designed to maintain economic stability. Two recent publications of the Joint Committee on the Economic Report, *Statistical Gaps* and *Economic Indicators*, are of especial interest in this connection.

Functions of the Joint Committee on the Economic Report

The Joint Committee on the Economic Report, consisting of 14 members drawn equally from the Senate and the House of Representatives, is one of two new agencies of government created to carry out the policies of the Employment Act of 1946 of:

> . . . creating and maintaining, in a manner calculated to foster and promote free competitive enterprise and the general welfare, conditions under which there will be afforded useful employment opportunities, including self-employment, for those able, willing, and seeking to work, and to promote maximum employment, production, and purchasing power.

The other new agency provided for is the three-member Council of Economic Advisers in the Executive Office.

The primary responsibilities of both the Council and the Joint Committee revolve around the Economic Report the President must submit each year soon after Congress convenes in regular session. This report analyzes and appraises the economic health of the nation and proposes a program for carrying out the mandates of the Act. It is the duty of the Council to assist the President in preparing the report. The Joint Committee on the Economic Report is required to (1) "make a continuing study of matters relating to the Economic Report"; (2) "study means of coordinating programs in order to further the policy of the Act"; and (3) "as a guide to the several committees of the Congress to report to the Senate and the House . . . its findings and recommendations" with respect to the matters contained in the Economic Report (by March 1).

Both the Joint Committee and the Council are empowered to make additional reports from time to time as a result of their work on the President's Report or which meet other needs in connection with the stabilization problem. As a result they are frequently called upon to bring together and point up materials from the many separate agencies of government. Growing out of this function are the two current reports, *Statistical Gaps* and *Economic Indicators*.

Members of the Joint Committee on the Economic Report

Senators:	Representatives:
Robert A. Taft, Ohio, Chairman	Jesse P. Wolcott, Mich., Vice Chairman
Joseph H. Ball, Minn.	George H. Bender, Ohio
Ralph E. Flanders, Vt.	Robert F. Rich, Pa.
Arthur V. Watkins, Utah	Christian A. Herter, Mass.
Joseph C. O'Mahoney, Wyo.	Edward J. Hart, N. J.
Francis J. Myers, Pa.	Wright Patman, Tex.
John Sparkman, Ala.	Walter B. Huber, Ohio

Members of the Council of Economic Advisers

Edwin G. Nourse, Chairman
Leon H. Keyserling, Vice Chairman
John D. Clark, Member

Current gaps in our statistical knowledge

The first of these two reports indicates a number of gaps in our present statistical knowledge which the Committee feels deserve discussion and consideration. No attempt has been made by the Committee to evaluate the importance of one project as against another, or to exhaust the list of potential statistical tools. These projects are listed with the simple purpose of evoking as widespread discussion as possible of the kinds of data which might be expected to contribute significantly to economic analysis. It is hoped, for example, that some readers will comment to the committee on the basis of the summary of projects given below. Others, before commenting, may wish to have copies of the Committee's report which gives a more complete presentation and includes a statement by the Bureau of the Budget on the cost of each project.

Statistical Gaps lists for consideration the following expansions or improvements in federal statistics:

(1) Periodic surveys of consumer purchasing power and demand, sufficient to show—

(a) the distribution of income and savings available for expenditures by geographic areas and among various consumer groups and income brackets, and

(b) current and prospective patterns of consumption and expenditures.

During the coming years much attention will be focused on all factors that influence consumer income and expenditures. Present data do not permit a sufficiently reliable analysis of the effect of possible tax reductions on consumer demand and savings. Little is known about the effect of recent price inflation on the real purchasing

power of various groups in the population, particularly those with relatively fixed incomes, and more information is needed about the ways in which various groups of individuals add to their savings, liquidate past savings, or incur consumer debt.

(2) Collection of information on wage earnings of employees in activities not covered by our social security system.

The basic source used in national income and employment estimates for current information on wages earned comes from the social-security records of employers reporting under the unemployment compensation, old-age and survivors insurance, and railroad retirement programs. The data from these records are satisfactory but they do not include the wage earnings of employees in noncovered employment—including public employees, agricultural workers, domestic servants, and employees of nonprofit institutions, who account for 25 per cent of all wages paid.

(3) Improvement of the information on returns to capital and management of unincorporated businesses.

Data on the returns to capital and management of incorporated businesses used in the estimates of national income are fairly satisfactory. Information on returns to capital and management for unincorporated business is much less complete. Particularly needed is more adequate information of this type for retail and wholesale trade, services, and farmers.

(4) Collection of more information on employment and unemployment, adequate to reveal geographic differences in employment trends and unemployment rates, and to provide data on occupational and other characteristics of the unemployed.

Statistics on employment and unemployment are among the most important indicators of the economic situation. The chief weakness of the currently collected monthly figures is that they fail to show employment and unemployment on a geographical basis, and that the sample is too small to provide reliable data on occupational and other characteristics of the unemployed. Expansion of the national sample to provide in full the desirable amount of detail would be excessively costly, but a moderate expansion to provide employment and unemployment totals for three major regions, with greater detail on characteristics of the unemployed for the United States as a whole deserves consideration.

The need for geographic detail can be met in part by annual surveys of individual metropolitan areas but these do not provide sufficiently current data in a period of rapid change. For this purpose primary emphasis must be placed on employment data reported by employers. State data of this sort are compiled by State employment security agencies and State labor departments in cooperation with the Bureau of Labor Statistics, which also compiles the corresponding national series, but area series are maintained by a few State agencies.

(5) Development of more complete and current information on financial trends in business, providing industry totals, data on business operations by size of business, and information on business concentration.

In 1946 and 1947 an interagency committee developed a coordinated plan for the collection of quarterly and annual financial reports. The initial sample was confined to manufacturing corporations, but the plan provided for expansion as rapidly as possible to include wholesale, retail, and service-trade corporations. The quarterly reports program covering manufacturing corporations was inaugurated in 1947 but the annual reports program has been postponed.

(6) Taking of an up-to-date census of wholesale and retail trade and services by means of which the current statistics on business and distribution may be improved and made more reliable.

In general, much better information has been available on agriculture, mining, and manufacturing than on wholesale, retail, and service trades, although for many purposes it is necessary to have adequate data on the total economy. Since it is probably impracticable to obtain very complete information on a current basis, it is important that censuses for this large segment of economic activity be taken at not too infrequent intervals.

(7) Development of adequate concepts for measuring productivity and the collection of data to supply information on the course of changes.

The measurement of productivity encounters peculiar problems of production measures, labor input, and price deflators in almost every industry. Satisfactory solutions to these problems will have to be found before the productivity measures themselves are expanded. To supply perspective, long-range historical studies should be made both of the changes which have taken place in productivity and of the causes of these changes. At the same time measures of changes in productivity are needed on a sufficiently current basis to make reasonable short-run estimates of future changes.

(8) Development of data on costs of construction and improvement of data on the volume of new housing and nonresidential construction.

There is a need for a reliable general construction-cost index for the United States and indexes for the principal types of nonresidential construction and the predominant types of residential construction in a sufficient number of localities to indicate differences in cost levels and trends.

Present series on the volume of construction are based on a combination of a number of data for residential and different types of nonresidential construction. In order to establish comparability of data derived from various sources extensive adjustments are made. Substantial improvements are needed both in the factual information required for such adjustments and to fill gaps in the basic data for certain parts

of the country and for certain types of construction.

(9) Improvement of inventory statistics by covering a larger and more reliable sample which would permit a break-down of inventories at the various stages in the industrial process.

One of the sensitive points in the working of the economic system is the inventory situation. Changes in inventories often have an important effect upon the business situation and may be an important and sensitive indication of the degree of business confidence.

Although some inventory statistics are now collected, a larger and more reliable sample of inventory figures is needed in order to provide additional important break-downs by industry by various stages in the industrial process, such as manufacturing, wholesaling, and retailing.

(10) Collection of detailed information on the relation of requirements for materials, capital equipment and energy to the volume of production, to permit evaluation of the industrial consequences of production programs.

Analysis of the relation between the production of finished goods and the concomitant requirements for power, components and materials is needed for appraising the impact of national defense, foreign aid and domestic economic programs on our industrial capacity, natural resources and manpower. Experimental interindustry relations studies have led to the development of a set of techniques which permit rapid evaluation of the major industrial consequences of any given production program.

(11) Collection of fuller information on business intentions with regard to capital expenditures and related data.

The level of output and employment depends to a very large extent on the rate of business investment, and the current rate of capital expenditure and the intentions of businessmen to invest in the coming year are important among the indicators of business confidence.

At present limited information is obtained on anticipated capital expenditures but the information now available is based on a small sample that is not adequate to provide any break-down by industries nor to determine to what extent investment plans are contingent upon changes in prices, costs, etc.

(12) Collection of more current and detailed information on expenditures of State and local governments, for use in preparing estimates for the Nation's economic budget.

We now have complete data on aggregate government expenditures, for all levels of government, only once in 10 years. Existing annual reports on State and local revenues and indebtedness have been fairly complete, but annual data are needed on expenditures also, from carefully selected sample surveys, and it would be helpful to obtain interim reports from a still smaller sample on a quarterly basis, in order to detect trends.

Information on State and local government public works, supplementing the Budget Bureau's 6-year survey of Federal public works, would be very useful in terms of the objectives of the Employment Act. In the years 1944 through 1947 information of this kind was collected by the Federal Works Agency in connection with its program of advance public-works planning, but no information on this sector of our economy is now currently available.

In addition to obtaining comments on its *Statistical Gaps* report the Joint Committee is anxious for widespread technical review of the monthly publication, *Economic Indicators*. It has requested the American Statistical Association to assist in getting a representative expression of opinion from the profession on both reports.

Current statistical guides for Congress

Economic Indicators is a monthly publication of charts and tables which the Council of Economics Advisers had originally drawn together for use within the Executive Office, covering selected series on The Nation's Economic Budget, Prices, Employment, Production and Business Activity, Purchasing Power and Money, Banking, and Federal Finance. These materials were made available to the Joint Committee on the Economic Report, who, in turn, felt that such a concise picture of current economic trends and developments would be helpful to other Members of Congress.

Since representatives of business, labor, and agriculture, consumer organizations, and the press had expressed an interest in having such a document, the Joint Committee arranged to print a limited number of *Economic Indicators* each month and also to make them available through the Superintendent of Documents. Both the Committee and the Council hope through the publication of these series to obtain a more common understanding and acceptance among interested groups of some of the basic statistical measures available for assessing and weighing our current economic situation. They will welcome comments on the philosophy behind the publication of *Economic Indicators*, its usefulness to particular groups, its contents, and the methods of presentation and will be glad to provide copies for review and discussion.

Copies of articles referred to in the text are available in limited quantities from the Joint Committee on the Economic Report, Senate Post Office, Washington 24, D. C.

The Census Bureau Training Program For Foreign Statisticians

by CALVERT L. DEDRICK
Bureau of the Census

For many years the Bureau of the Census has provided facilities for foreign statisticians to study the content and procedures of American Censuses. Until 1947 such studies were conducted on an informal basis, principally through individual consultations with the professional and administrative staff of the Bureau. Such informal conferences are still conducted for all visiting technicians except trainees from Latin America for whom a formal program was organized in 1946 in accordance with laws providing for the cooperation of this Government with the 20 American Republics. With the passage of the U. S. Information and Educational Exchange Act of 1948, it is probable that the Bureau's program will be expanded in the future to provide for training grants and formal courses for technicians from other countries of the world.

The interests of foreign technicians who visit the Bureau of the Census are nearly as comprehensive as the fields of statistics. Until recently the majority of visitors sought information concerning the content and conduct of censuses such as population, agriculture, manufactures, business, mining, etc. Others were interested in mechanical tabulation and equipment, employee training, statistical agency administration, preparation of reports, publication policies, etc. Since 1940 an increasing number of specialists in sampling have taken in-service training in the Office of the Statistical Assistant to the Director for periods of from a few days to a year. The "samplers" are now the largest single group except for the trainees from the American Republics. During the past year the sampling specialists who have studied in the Bureau have come from India, Pakistan, Siam, China, Egypt, France, and Portugal. Individual programs are worked out for each visitor in accordance with his needs, technical preparation and the time available for study in the Bureau. Because many of these sampling specialists are well-trained in mathematics and statistics, they are permitted to sit with the staff in the consideration of various theoretical and practical problems presented by the Bureau's program, and some of them have contributed methodological notes or papers as a result of their studies. Since the recent Congress did not provide funds for the implementation of the U. S. Information and Educational Exchange Act of 1948 for areas other than Western Hemisphere, all of the Eastern Hemisphere technicians are in the Bureau at their own expense or that of their own government.

The Latin American Program

The Bureau's training program for Latin American statisticians is one of the projects supported by the Interdepartmental Committee on Scientific and Cultural Cooperation of the State Department. For the past 5 years this Government has been aiding in the cooperative preparations necessary for the taking of the 1950 Census of the Americas, that is, the program for coordinating the 22 population censuses of the American nations. Various activities to this end were undertaken by the Bureau of the Census and other Federal agencies soon after the creation of the Inter-American Statistical Institute. This Institute named a Committee on the 1950 Census of the Americas in 1946, and appointed the Coordinator of International Statistics, U. S. Bureau of the Census, as chairman. (The Coordinator is also in charge of the Bureau's training program for foreign statisticians.) Considerable progress has been made in the preparation of plans for common items, definitions and tabulations to be included in the next censuses of population and agriculture in the Western Hemisphere nations. Many international organizations are interested in this project. Among these, special mention should be made of the United Nations, the Food and Agriculture Organization, the International Labor Office, the World Health Organization, and the Caribbean Commission.

The broad U. S. Government program for statistical cooperation with the other American Republics is conducted cooperatively under the leadership of the Bureau of the Census, by this Bureau and the Bureau of Agricultural Economics, the Bureau of Labor Statistics, and the National Office of Vital Statistics. The general objectives of each of these agencies, working with its corresponding agency in each country, can be summarized briefly as follows:

1. To give technical assistance to officials and agencies taking censuses of population, agriculture, industry, business, mining and compiling other statistical data;

2. To assist in the integration of census work with related statistical activities;

3. To assist in strengthening the statistical staffs and organizations of the Americas.

Under this broad program, not only are technicians brought to the United States for training, but American consultants are sent to Latin American countries to give on-the-job assistance, and there is a growing exchange of special information in two or more languages.

The training of Latin American statisticians in the United States has been and is one of the outstanding aspects of this program. Nearly 100 technicians have been awarded grants by these various agencies. All of the Latin American Republics have received such training grants, and an increasing number are availing themselves of the opportunity to send their best young economists and statisticians to the United States for advanced study.

The Inter-departmental Committee on Scientific and Cultural Cooperation allocates funds to the cooperating agencies to finance a limited number of training grants to foreign technicians. Each trainee is required to be a citizen of his country; to be an employee of an agency under governmental jurisdiction; to be able to speak, read and write English; to have successfully completed an equivalent of a 4-year university course; and to have a regular position to which he will return and for which a salary will be paid for the support of his dependents during the period of his training. Each of the cooperating agencies awards its own grants.

The training offered by the Census Bureau includes instruction courses and wide opportunities for study and research in the broad field of census experience. Though designed especially to assist the other American Republics in the preparations for and conduct of their periodic censuses, the program also aims to provide certain basic training for technicians engaged in various types of current statistical work. An opportunity is given for these foreign statisticians to obtain class-room instruction and practical field and laboratory experience in the taking of censuses of population, agriculture, industry, mining, business, and other subjects, and in the conduct of other large-scale statistical operations.

Types of Training

The principal types of instruction given to trainees are:

A Conference courses designed to provide the trainee with adequate background information on (1) the organization and administration of the United States Bureau of the Census and, if necessary, other Federal agencies; (2) the sources of statistics of various kinds in the United States; (3) the nature and scope of periodic censuses; and (4) the relation of censuses to other statistical data collected and analyzed by U. S. agencies.

B Seminars, laboratory exercises, and observation of work in the Census Bureau and other agencies of detailed topics of interest to the trainee, such as (1) preparation of census questionnaires, (2) methods of field enumeration, (3) procedures for editing and coding statistical forms, (4) use of mechanical equipment, (5) methods of classifying industrial and business establishments, imports and exports, etc., (6) techniques of making intercensal estimates, (7) sampling procedures, and (8) other topics.

C Such field training and special research as appears advisable to the Director of the Census.

The formal class-room courses and subjects taught to date include:

1. Statistics for Demographers

General survey of the statistical techniques and methods employed in demographic studies with special emphasis on the manipulation and analysis of census data. The course is presented in two lectures and one laboratory session weekly.

2. Population Problems.

Study of population doctrines and theories, with emphasis on the dynamic forces affecting population growth. The composition of the populations, including the labor force, is studied from census data, as well as the factors contributing to changing birth and death rates. The problems of quality and the evolution of national population policies are also treated.

3. Industrial Statistics

Survey of industrial statistics, the principles that govern their collection and analysis, and a study of the methods now practiced in several of the American Nations. The course is presented as a series of student seminars and problems, with occasional lectures by the instructor and experts in the various fields.

4. United States Governmental Organization

Review of the organization of the government of the United States; the federal structure and the functions of governmental organizations. Particular attention is given to agencies which collect and publish statistics. The course is presented by means of lectures, with references to appropriate literature.

5. The 1950 Census of the Americas

Survey of the census statistics of the American Nations with special emphasis on standardization and coordination with the proposed "1950 Census of the Americas" program. Census experience in this hemisphere in the fields of population and agriculture is reviewed and current census methods and results are analyzed.

6. Census Organization and Administration

General survey of the organization of census programs and the administration of census offices, both permanent and temporary Census legislation, budgets, personnel practices, training methods, office procedures, field enumeration and supervision, analysis of results, and presentation of census reports.

Those trainees who will be concerned with the direction of population surveys and censuses are enrolled in Columbia University for two months of study following their class work in the Census Bureau. Under the guidance of the Bureau of Applied Social Research, they are given intensive work in methods of social research, sociology, and field enumeration involving the collection of census-type data from Spanish-speaking families in New York.

This specific training program was first begun in the summer of 1947, with 20 Latin American statisticians in attendance. A second cycle of courses was given from October 1947 to January 1948 during which time 28 persons were trained. A third cycle has been conducted this summer for 28 trainees. Ten other trainees are now in the U.S. preparing for their studies this winter.

These trainees represent men and women from all parts of Latin America who have come to Washington to study a number of subjects in various Federal agencies. Of the 76 trainees who have finished the census course, 36 were accredited directly to the Census Bureau and 40 to other agencies, principally the Bureau of Agricultural Economics, the National Office of Vital Statistics, the Bureau of Labor Statistics, and the Office of Business Economics. Thus, the Census Bureau, in accordance with the over-all plans of the Inter-departmental Committee on Scientific and Cultural Cooperation, provides a minimum basic statistical training for all these trainees, regardless of the specialized nature of their interests and needs. Trainees from other agencies ordinarily spend four months in the Census Bureau and from two to eight months in the agency handling the subject matter in which they are specializing.

Doomsday Book for Scotland CONTINUED FROM PAGE 9

Church of Scotland, and also of the clergy of other denominations, we hope to have the help of local doctors, schoolmasters, district nurses, registrars, and others who have knowledge of the history and life of their own parishes. It is suggested tentatively that our Account should be based upon the following headings:

(1) Physical features
(2) History of the local community
(3) Population
(4) Public and social services
(5) Housing
(6) Agriculture, industries and commerce
(7) Way of Life

The first six headings are self-explanatory. The seventh, "Way of Life," by far the most important, is really the kernel of the whole matter. In this portion it is suggested that the local people should show how all the previous headings are inter-related and contribute to the way of life of their particular community. It would include any special and unique characteristics and the extent to which local consciousness and civic pride have grown or declined in the community during the last century, and generally describe how the community has evolved its special way of life.

We wish to know about family life, social groups, social welfare, education, libraries, newspapers, etc., with a view to showing how all these are involved in the way of life of the community. Our main task will be to describe not merely the physical facts, the social conditions and industries, but to show how the people *live*, and what they think about religion, their work and their leisure. We are anxious to know whether any significant changes have occurred in the customs of the people and their attitude to life generally, and their hopes and prospects for the future.

It may be asked what good this account will do in the rebuilding of a society whose way of life has been altered by two World Wars and the disturbances which have followed in their train? The promoters of this Third Account feel that unless the local condition and the view of the local people are known, the problems which life places before those who are planning for the future will be difficult to measure and therefore hard to solve.

The task is an immense venture of faith in which we require the cooperation of large numbers of our fellow men. When the first four preliminary volumes are completed we will be able to gauge the problems and difficulties which lie ahead, and we expect to learn from the experience of these early surveys how to overcome the difficulties we are sure to meet before we complete our great task.

We intend to issue a volume for each county containing the parish Accounts. It may be that one volume will be sufficient to contain the parish Accounts of two of the smaller counties. We hope to issue separately Accounts for the individual parishes. After the county surveys are complete it is our intention to issue one or more Summary Volumes reviewing the country as a unit. There are certain features of Scottish life, history, customs and conditions which apply to the country as a whole, and these would be reviewed in our national volumes.

The Outlook for Women in Statistics

by MARGUERITE WYKOFF ZAPOLEON
Women's Bureau
U. S. Department of Labor

Statisticians appear to have been too busy with other problems to apply their techniques to the study of their own occupation. Statistics on statisticians are scarce as compared with those, for example, on physicians, nurses, and teachers.

This may be attributed to a number of factors, aside from the lack of introspection or time on the part of statisticians. As a full-time occupation, statistics is an infant in relation to certain long-established occupations which have matured beyond the uncertainties of adolescence and which are sometimes accused of showing signs of old age. Statisticians, also, are relatively few in number. Only 5,000 persons are members of the American Statistical Association in 1948 and less than 4,000 were registered in statistics with the National Roster of Scientific and Specialized Personnel at its peak 1944 registration. So small a group cannot obtain as much statistical attention as can those in occupations exceeding the 100,000 mark, as many do.

Perhaps even more complicating than these factors is the dual role of statistics which, on the one hand, is an essential tool in many professions and, on the other, is the primary concern of the statistician. Only in music and a few other fields is the line between the specialist and the one who can perform on occasion so difficult to draw. Announcements of the qualifications for examination for Federal Civil Service positions at the beginning professional level in statistics reflect this dualism. To qualify for an examination for selection as a junior professional assistant with option as statistician, for instance, in 1947 a college graduate might offer as his specialized educational qualification either 20 semester hours of work in statistics or 6 semester hours in statistics combined with 24 semester hours in any one or any combination of the following: economics, agricultural economics, sociology, political science, social service, education, psychology, home economics, biology, public health, agriculture, mathematics, engineering, or physics. At the higher levels, too, classification as a statistician is often difficult because of the individuals, who, beginning in one field, become qualified through experience or further training as specialists in more than one field.

Type of employment

The Women's Bureau of the U. S. Department of Labor, in its recently published bulletin on the outlook for women in mathematics and statistics, made no attempt to assemble information on the many women in the social sciences, education, psychology, home economics, and other fields who use statistical techniques to a large extent in research work or who may even instruct others in these techniques as applied to their primary subject-matter field. Its emphasis was rather upon the women in statistics who approach the field with basic background in mathematics.

Less than 50 women in the United States were found listed in 1946-47 college and university catalogues as instructors or other faculty members in statistics, if a sample count made by the Women's Bureau from the catalogues of 330 institutions of higher education (selected by the U. S. Office of Education as representative in their enrollments of the 1,749 institutions of this type) supplies a true picture of the faculty distribution in all. There were probably many more women listed on the faculty in other subject fields who taught one or more courses in statistics as well. For example, undoubtedly some of the 1,710 women faculty members in mathematics, according to an estimate based on a similar count, may have had courses in statistics in their teaching schedule.

Teaching, however, has not been the principal outlet for statisticians as it has been for mathematicians. Industry, business, and Government have absorbed more. Nearly two-fifths of the men and women members of the American Statistical Association in 1945, according to an article published in 1946 in the Association's Journal were in Government, most of them in the Federal Government. Another fifth were in manufacturing industries and financial institutions. Less than one-fifth were in colleges and universities. A very different distribution, however, was found among the members of the Institute of Mathematical Statistics who are interested primarily in statistical theory and technique. More than half of the members of the Institute were in academic positions according to a 1947 publication of the National Research Council. Separate figures on women were not available. But the distribution of women is believed to be more like that of men in statistics than in some other fields where there is a more definite preference for men in certain specializations.

The demand for statisticians did not taper off after the war, but continued strong in all fields. In a 9-months period which extended into the postwar year of 1946,

the National Roster of Scientific and Specialized Personnel reported 30.7 vacancies in statistics for every 1,000 registrants in that field. For those registered in mathematics, the corresponding number of vacancies was only 4.4 for those in physics, 23.9. The Roster rarely received requests from colleges which recruited directly. This may explain in part, but only in part, the much lower ratio of vacancies to registrations in mathematics where the demand is largely in the academic field.

That the demand for statisticians in colleges is also great was revealed by an inquiry in April 1946 conducted by the National Research Council's Committee on Applied Mathematical Statistics. Thirty leading authorities in mathematical statistics reported 135 requests (some of which may have been duplicating) from academic institutions for persons with Ph.D.'s in mathematical statistics or in such fields as agronomy, biology, economics, or psychology if combined with a minor in statistics. About 140 requests were received from business and industry, most of them for positions in industrial quality control and in engineering, but also many for sampling experts in market research organizations. Educational requirements ranged from the bachelor's degree to the doctorate.

Employment in Government and Private Industry

The Government demand for statisticians is reflected in the residence of members of the American Statistical Association. About half of the members of the Association reside in the Washington, D. C., metropolitan area or in New York State. Women statisticians are employed in the Federal Government in such statistical agencies as the Bureau of the Census, the Division of Statistical Standards of the Bureau of the Budget, and the Bureau of Labor Statistics. In the April 1948 Federal Statistical Directory, women were also listed as statisticians or heads of statistical units in such agencies as the U. S. Public Health Service, the Bureau of Foreign and Domestic Commerce, the Social Security Administration, the Public Housing Authority, the Children's Bureau, the Women's Bureau, the National Bureau of Standards, and the War Assets Administration. In the National Defense Agency, too, women are employed as statisticians in various units of the Army and the Navy.

During the war, a number of women were trained in statistical methods applied to quality control in such Government units as Ordnance in the War Department. Others were enrolled in short intensive Engineering, Science and Management War Training courses for similar training in preparation for work in war industries. The wartime saving of time and manpower through the use of statistical control was impressive and is in part responsible for an acceleration of the demand for statisticians in industry. The Committee on Applied Mathematical Statistics of the National Research Council in its 1947 report listed the demand for industrial statistics in quality control, research, and development as one of the fields in which recent growth in opportunities for statisticians has been especially great. Others are: research in the biological sciences; the collection and analysis of Government statistics; market research and commercial sample surveys; and psychological testing.

While the demand in Federal war agencies and in war industries was given more attention during the war years, the demand for statisticians continued in State and local Government. Boards of education in large communities, for example, often employ at least one statistician; in some cases a statistician supervises the entire research and psychological testing programs. According to a study reported in a 1945 issue of the *Journal of the American Statistical Association*, State agencies, especially departments of labor or industry, departments of welfare, and departments of health, employed or had vacancies in 1944 for an estimated total of over 600 statisticians and nearly 1,100 statistical clerks. Other State agencies employing statisticians or statistical clerks were State departments of highways, agriculture, taxation, education, banking, and insurance. The general trend toward utilization of statistical personnel in State agencies and the lack of expansion of these agencies during the war suggest that the total employment in State agencies is greater now than it was in 1944.

Women have long been in demand for statistical work in insurance offices. According to reports from college placement bureaus, mathematics majors with training in statistics were especially in demand before the war for this type of work. During the war, as women were drawn into engineering departments and other technical services in war industries and in Government, the demand in insurance companies was left virtually unfilled, and only recently have placements in this field been resumed. The nature of the work often continued at the statistical clerk level rather than at the statistician level. However, some women in insurance companies have reached the ranks of the actuaries' assistants, and a few exceptional women have reached the top as actuaries. Eight examinations are required for qualification as a fellow in one of the actuarial societies. Only twelve women were among the 562 Fellows of the Actuarial Society of America in 1947, and only 11 women were among the 301 associates. A prominent women actuary is quoted by the Women's Bureau as saying: "A woman can succeed in this field, but she has to be 50 per cent better than her nearest male competitor to do it."

Favorable outlook for women

Compared with their 3 per cent ratio in actuarial work, women find more favorable their 10 per cent ratio among

CONTINUED ON PAGE 29

German mines laid in British channels, British mines in German channels and U. S. mines in Japanese channels. Other such constants were the number of submarine torpedoes expended per ship sunk, the percentage of U-Boats which could be attacked by aircraft after a sighting, and the number of ships in a convoy sunk by a single attacking submarine. Professor P. M. S. Blackett, the British operations analyst, who first pointed out the existence of these operational constants, concluded that the stability of certain factors over long periods of time was due to the fact that neither the tactics nor the technical instruments of warfare could be changed very rapidly due to the finite time required for training and development. However, a more fundamental explanation was advanced by Dr. P. M. Morse, director of the U. S. Navy Operations Research Group. Morse contended that nearly all operations in our technological society involve the operation of men *and machines*, and the machines force regularity on operations involving them. Thus, although each pilot may have his own method of attack, none of them can overcome the limitations in speed, endurance and turning radius imposed on him by the characteristics of the plane. The chief reason for the invariance of certain operational parameters, in spite of wide variations in extraneous circumstances, was that the equipment involved was approximately the same. Just as soon as the Germans made a radical change in their submarine design the constants for sighting and attack underwent a marked change. These constants are the sine qua non of operations research for no analysis would mean anything if they did not exist. One of the first steps in the extension of operations research into other fields will be to discover what the operational constants are in each particular application.

Prediction is the goal of all operations research

While the gathering of statistics and a study of the operational constants is a necessary first step in operations research, it does not by itself suffice; for we must prepare for future actions. Suppose that submarine sightings were steadily diminishing in the face of a constant search effort—what conclusions can we draw and how are we to cope with this situation? Suppose that we wish to introduce a new weapon—can we predict what effect it will have on future operations if we know its characteristics? Is it worth the effort on our part to produce and use this weapon? To give a clear-cut answer to these questions requires more than just bare facts. It requires a theory to explain why things happen as they do so that we may predict the effect of any changes in the operating conditions with reasonable certainty.

The formulation of a procedure for predicting the effect of a change in operating conditions may proceed in two ways. If sufficient operational data is available on the effect of varying certain conditions then it merely requires careful statistical analysis of the data to establish the quantitative dependence of the outcome of the operation upon the quantity which is being changed. An example of this is the effect of meteorological visibility upon the range of visual sighting of ships from aircraft. Since aircraft carry on search in all visibilities, the range of sighting as a function of visibility may be obtained directly by tabulating the data from aircraft mission reports and eliminating the effect of other variables such as altitude of aircraft, number of look-outs, type of aircraft, etc. Thus one can obtain the *average* range of sighting under given meteorological conditions. Since the laws of chance will, of course, influence the results it will still be possible for two planes to operate under identical conditions and still report different ranges of sighting. However, when hundreds of missions are flown per month we are not interested in predicting the outcome of a single encounter but require only a measure of the average performance of all aircraft assigned to that duty.

In most cases the operational data are insufficient to permit the application of the procedure outlined above. It is necessary then to proceed with the much more difficult task of formulating a theory based on the known laws of physics, mathematics and physiology and also consistent with those few observations that are available. Suppose that most of the aircraft used for sea search fly their missions at four thousand feet because of certain pre-conceived ideas on the part of the pilots or operations officers, and an operations analyst has been given the job of finding out whether this altitude is better than either a higher or lower altitude for getting the best ranges of sighting. An examination of the data shows a large dispersion in the ranges of sighting at all altitudes and after the effects of visibility, etc. have been eliminated, the only reliable average is obtained for flights at the four thousand foot level. Lacking the necessary operational data, the analyst temporarily lays aside the statistical approach and proceeds to study the problem theoretically. He knows something of the characteristics of the human eye, its sensitivity for objects of different contrast and its method of scanning. He applies the physical laws which relate to this problem and obtains a mathematical solution which shows that higher flight altitudes would give considerably increased ranges of sighting against the particular targets considered. In view of the large gain in effectiveness to be expected from a change in flight altitude, a set of operational tests are scheduled to simulate the search problem as closely as possible.

If these tests bear out the calculations, then there is sufficient evidence to warrant a change in the flight doctrine requiring prescribed altitudes of flight under given conditions. If the results of the tests differ appreciably from the calculated values then a further review of the problem is necessary until the discrepancy is removed. The advantage of this method of procedure over that outlined in the previous paragraph is that the basic features of the operation can be regarded as well understood and we can, with confidence, predict the outcome of a search operation against different types of targets, the effect of faster planes, the effect of camouflage, and other variables which enter into the solution of the problem. If, as in the previous case, sufficient data had been available to indicate that, say, eight thousand feet was the best flight altitude then the effectiveness of the operation could have been improved by requiring all future search flights to be carried out at eight thousand feet, but without an adequate theory we could not apply these results to other situations. As equipment and conditions changed the optimum flight altitude would also be different. However, since all planes would be flying at eight thousand feet this would not be discovered. It is obvious therefore that considerable effort should be devoted to formulating a complete theory for any operation under study. There is no stock method for the formulation of such a theory. Each operation must be dealt with separately although certain fields can sometimes be covered with a broad general theory which contains particular problems as special cases. An example of this is the previously discussed problem of visual search. Analogous treatments exist for radar search and underwater sound search. In fact a general search theory can be developed which includes each of these types as a special case. However, search theory covers only a small part of military operations which in turn represent only a small part of all the complex operations which can be treated by these methods. Nevertheless, the ability to solve problems in one field gives the analyst a certain amount of "know how" and confidence to tackle problems in other fields.

The Scope of Operations Research

This brief discussion cannot do full justice to the scope of operations research. During the war operations research was carried out at three distinct levels, the technical, tactical and strategical. Technical problems were usually concerned with evaluating the performance of a weapon or weapon system such as the accuracy of torpedo fire, AA gunfire, new types of bomb sights, lethal effect of depth charges, etc. Tactical problems involved the optimum use of equipment and were manifest in the formulation of bomb salvo spacings, depth charge patterns, search plans and similar problems involving the coordination of men and equipment to attain maximum effectiveness in a particular operation. The strategical problems involved questions of the disposition of forces and concentration of effort in particular lines of endeavor. One such problem was the apportionment of aircraft assigned to anti-submarine duties among their three principal functions; convoy escort, offensive warfare against submarines at sea, and strategic bombardment of factories and bases. Such problems frequently involve not only economic considerations, but also assumptions as to the expected sequence of events. The above mentioned problem involved such considerations as the rate of loss of shipping compared with our anticipated construction rate, expected length of the war, the question of whether the supplies carried by our ships were needed immediately or being stockpiled for a future offensive, etc. In such cases, the sensitivity of the answers on the particular assumptions must be thoroughly discussed, and several alternative plans with their expected consequences should be presented to the executive who must make the decision on the basis of the information furnished him.

The examples in this article have all been slanted toward military problems because the opportunity to try these methods first arose in that field. The problems occurring in the industrial and governmental fields will all follow the same pattern and fit into one of the three categories; technical—the performance of machines, tactical—the best use of machines by the men assigned to them (not to be confused with time and motion studies or other systems research), and strategical—the optimum division of effort in different lines of activity. At the moment our immediate problem is to bring these methods to the attention of administrators in private industry and governmental units (especially city administrators) and to point out to them the need for a scientific approach toward a better understanding of the operation of their complexes.

. . . make your reservations early . . .

108th Annual Meeting of the AMERICAN STATISTICAL ASSOCIATION

December 27-29, 1948 Hotel STATLER Cleveland, Ohio

108th Annual Meeting of the AMERICAN STATISTICAL ASSOCIATION

December 27-29, 1948, Hotel Statler, Cleveland, Ohio

MONDAY—DECEMBER 27, 1948

9 A. M.
Mezzanine

Registration

Permanent Graphic Exhibit **How *Not* to Present Statistics**

10 A. M.-NOON
Euclid Room
Papers

Special Feature

Chairman: Stuart A. Rice, Bureau of the Budget

Basic Features of a National System of Statistical Intelligence
Frederick C. Mills, National Bureau of Economic Research

Statistical Requirements for Economic Mobilization
Ralph J. Watkins, National Security Resources Board

Discussion

John W. Tukey, Princeton University
Donald R. Belcher, American Telephone and Telegraph Company

10 A. M.-NOON
Ohio Room
Papers

Sampling in Marketing Research

Joint with American Marketing Association

Chairman: (To Be Announced)

How to Obtain Dependable Samples in Marketing Research
Morris H. Hansen, Bureau of the Census

Sampling of Magazine Audiences
Theodore H. Brown, Harvard University

Discussion

Lester R. Frankel, Dun & Bradstreet, Inc.—Arnold J. King, National Analysts, Inc.—Warren N. Cordell, A. C. Nielson Company

10 A. M.-NOON
Tavern Room
Papers

Population Statistics

Joint with Population Association of America

Chairman: Henry S. Shryock, Jr., Bureau of the Census

Subregional Migration as an Area of Research
Warren S. Thompson and Donald J. Bogue, Scripps Foundation

Unemployment and Migration in the Depression (1930-35)
Ronald Freedman and Amos Hawley, University of Michigan

Prospects for Improved Methods of Forecasting Population
John Hajnal, United Nations Secretariat

10 A. M.-NOON
Parlor 3

Symposium on Statistics for the Clinician—Clinical Problems

Biometrics Section joint with the Biometric Society

Chairman: Joseph Zubin, Psychiatric Institute, Columbia University

Papers

Statistical Problems in the Treatment of Case Histories
Alfred L. Baldwin, The Fels Research Institute, Antioch College

Statistical and Experimental Factors in the Diagnosis of Consciously Suppressed Affective Experience
Joseph F. Kubis, Fordham University

Problems of Multi-Judge Reliability
Leonard S. Kogan and J. McV. Hunt, Institute of Welfare Research Community Service Society, New York City

Statistical Problems Involved in Rorschach Patterning
Albert I. Rabin, Michael Reese Hospital, Chicago

Statistical Problems in Multi-score Tests
Lee J. Cronbach, Bureau of Research and Service, University of Illinois

By Title

Statistical Problems in Diagnostic Patterning and Pattern Analysis
David Wechsler, Bellevue Psychiatric Hospital, New York City

Experimental Designs for the Rorschach Test
William Stephenson, Visiting Professor, University of Chicago

Discussion

John C. Flanagan, University of Pittsburgh

NOON-4 P. M.

Statistical Quality Control

Luncheon

Joint with American Society for Quality Control

Pine Room

Chairman: Wade R. Weaver, Republic Steel Corporation

Papers

Application of Statistical Quality Control to the Verification of Punched Cards
Benjamin J. Tepping, Bureau of the Census

Group Sequential Plans for Sampling Clerical Work
Howard L. Jones, Illinois Bell Telephone Company

Discussion

Guy G. Parkin, Minnesota Mining and Manufacturing Company

Harold Haines, Nathan Manufacturing Company

2-4 P. M.

Review of Recent Advances in Mathematical Statistics

Ohio Room

Joint with Institute of Mathematical Statistics

Chairman: Churchill Eisenhart, National Bureau of Standards

Papers

Statistical Concepts in a Finite Number of Dimensions
William G. Madow, University of Illinois

Statistical Concepts in an Infinite Number of Dimensions
David H. Blackwell, Howard University

2-4 P. M.

Statistics in Social Security

Tavern Room

Chairman: W. Rulon Williamson, The Wyatt Company

Papers

Beneficiary Statistics under the Old Age and Survivors Insurance Program and some Possible Demographic Studies Based on these Data
Robert J. Myers, Social Security Administration

By-Product Data and Forecasting in Unemployment Insurance
Nathan Morrison, Division of Placement and Unemployment Insurance, State of New York

Development through a Federal-State Research Program of Nationwide Information on Public Assistance
Anne E. Geddes, Social Security Administration

2-4 P. M. — **Panel Discussion of Medical Statistics**

Parlor 3 — *Biometrics Section joint with the Biometric Society*
Moderator: James A. Rafferty, School of Aviation Medicine, Randolph Field.

Topics

Multiple Factor Analysis Applied to Clinical Problems
Marshall Brucer, University of Texas Medical Branch

Clinical Statistics as Affected by Incompleteness of Clinical Records
G. M. Leiby, Birmingham Veterans Demonstration Hospital, Van Nuys, Calif.

Statistical Problems of Medical Diagnosis
Jerzy Neyman, University of California

Sequential Analysis in Clinical Research with Examples from Nutritional Studies of Toxemias of Pregnancy
Nevin Scrimshaw, University of Rochester Medical School

Some Inadequacies of Statistical Methods in Dealing with Case History Data
Carl C. Seltzer, Grant Study, Harvard University

Compound Symmetry Tests in the Multivariate Analysis of Medical Experiments
David F. Votaw, Jr., Yale University

Discussion — Audience participation invited

4-6 P. M. — **Business Statistics and Management**

Pine Room — *Chairman:* Donald M. Hobart, Curtis Publishing Company

Papers

Business Research and Policy Determination
Hal E. Nourse, United Air Lines

Statistical Aids to Management
Donald R. G. Cowan, Donald R. G. Cowan Associates

Discussion — C. E. Skinner, Gulf Oil Corporation—Joel Dean, Columbia University

4-6 P. M. — **Developments in Sample Survey Methodology**

Euclid Room — *Chairman:* Clyde W. Hart, National Opinion Research Center

Papers

Factors Affecting the Refusal Rate in Interviewing
Charles F. Cannell, Survey Research Center, University of Michigan

Response Errors in Survey Research
Eli S. Marks and W. Parker Mauldin, Bureau of the Census

Interviewer Errors in Survey Research
Herbert H. Hyman, National Opinion Research Center

Discussion — Julian A. Woodward, Elmo Roper and Associates—Richard S. Crutchfield, Swarthmore College

4-6 P. M. — **Contributed Papers in Mathematical Statistics**

Ohio Room — *Joint with Institute of Mathematical Statistics*

4-6 P. M. — **Symposium on Statistics for the Clinician—Proposed Solutions**

Parlor 3 — *Biometrics Section joint with Biometric Society*

Chairman: Joseph Zubin

MONDAY

Papers

A Statistical Approach to Typology
William Stephenson, Visiting Professor, University of Chicago

Scaling Techniques
Eric F. Gardner, Syracuse University

Intra-Individual Variability
Daniel Horn, American Cancer Society

Unitizing and Categorizing Problems in Coding Qualitative Data
Harold Guetzkow, University of Michigan

Basic Principles for Construction and Application of Discriminators
George W. Brown, The RAND Corporation

Discussion

John W. Tukey, Princeton University

8-10 P. M.

Teaching Statistical Quality Control

Pine Room

Section on Training of Statisticians joint with American Society for Quality Control and Institute of Mathematical Statistics.

Chairman: Samuel S. Wilks, Princeton University

Papers

Instructional Aids for Statistical Quality Control
Edwin G. Olds, Carnegie Institute of Technology

Teaching Statistical Quality Control for Town and Gown
Lloyd A. Knowler, State University of Iowa

8-10 P. M.

Contributed Papers

TUESDAY—DECEMBER 28, 1948

8-10 A. M.

Meeting of Chapter and District Representatives

Breakfast

Chairman: Merrill M. Flood, American Statistical Association

Parlor C

10 A. M.-NOON

Special Feature

Ohio Room

Chairman: Gertrude M. Cox, Institute of Statistics, University of North Carolina

Papers

Statistical Problems in Measuring the American Standard of Living
Dorothy S. Brady, University of Illinois

The Use of Statistics in Personnel Selection and Classification
Walter L. Deemer, Jr., Lt. Col., U. S. A. F.

Discussion

Robert W. Burgess, Western Electric Company

10-11 A. M.

Business Meeting of the Institute of Mathematical Statistics

Tavern Room

Chairman: Henry Scheffé, Columbia University

10 A. M.-NOON

Current Research in Business Cycles

Hotel Cleveland

Joint with American Economic Association and Econometric Society

Chairman: Bernard F. Haley, Stanford University

Papers

Business Cycles in the Inter-war Period; the Quantitative-Historical Approach
R. A. Gordon, University of California

The Econometric Approach to Business Fluctuations
Tjalling C. Koopmans, Cowles Commission for Research in Economics, University of Chicago

Discussion — Gottfried Haberler, Harvard University—James W. Angell, Columbia University—Lloyd A. Metzler, University of Chicago—Arthur F. Burns, National Bureau of Economic Research

10 A. M.-NOON — **Broadcast Measurement in the Radio Field**

Euclid Room — *Joint with American Marketing Association*

10 A. M.-NOON — **Business Statistics: Some Applications**

Pine Room — *Chairman:* Corwin Edwards, Federal Trade Commission

Papers

Methods Employed in the Forecast of a Concern's Business
Charles F. Roos, The Econometric Institute, Inc.

The Engineer and Business Statistics
Paul S. Olmstead, Bell Telephone Laboratories

Discussion — Donald H. Davenport, Department of Commerce, State of New York—Jules Labarthe, Jr., Mellon Institute of Industrial Research

10 A. M.-NOON — **The Second Statistics Course**

Parlor 1 — *Section on Training of Statisticians*

Chairman: George W. Snedecor, Statistical Laboratory, Iowa State College

Speakers

W. Allen Wallis, University of Chicago
Helen M. Walker, Columbia University
Lowell J. Reed, The Johns Hopkins University

Discussion — Frederick J. Mosteller, Harvard University—Paul Peach, Institute of Statistics, University of North Carolina

10 A. M.-NOON — **Round Table on Morbidity Statistics**

Parlor 3 — *Biometrics Section joint with American Public Health Association and Biometric Society*

Chairman: Hugo Muench, Jr., Harvard University

NOON-4 P. M. — **The 1950 Census Tract Program**

Luncheon — *Committee on Census Enumeration Areas*

Mid-Day Club (925 Euclid Ave.) — *Chairman:* Howard Whipple Green, Cleveland Health Council

Papers

Requirements in 1950 Census Tract Program
A. Ross Eckler, Bureau of the Census

Proposed Tabulations for 1950 Census Tract Cities
Leon F. Truesdell, Bureau of the Census

The 1950 Census Tract Areas
C. E. Batschelet, Bureau of the Census

New Canadian Census Tract Cities
O. A. Lemieux, Dominion Bureau of Statistics, Ottawa, Canada

A Vital Statistician Puts Census Tracts to Work
W. Thurber Fales, Baltimore City Health Department

Discussion — Series of Brief Reports from Key Persons in Various Census Tract Cities

NOON-2 P. M. — **Section on Training of Statisticians—Business Meeting**

Luncheon — *Chairman:* W. Allen Wallis, University of Chicago

Tavern Room

Talk — The Importance of Statistics for Higher Education
(Speaker to be announced)

NOON-2 P. M. — **Proposed Section on Business Statistics—Organization Meeting**

Luncheon — *Chairman:* John H. Cover, University of Maryland

Parlor C — *Discussion leaders:* Dexter M. Keezer, McGraw Hill and Company
Lester S. Kellogg, Deere and Company

2-4 P. M. — **Review of Statistical Methodology**

Euclid Room — *Joint with Institute of Mathematical Statistics*

Papers — *Chairman:* Frederick Mosteller, Harvard University

Surveys and Sampling
Phillip J. McCarthy, Cornell University

Industrial Applications
Paul S. Olmstead, Bell Telephone Laboratories

Economics, Business, and the Social Sciences
W. Allen Wallis, University of Chicago

Biology, Physical Sciences, and Experimental Design
W. J. Youden, National Bureau of Standards

4-6 P. M. — **Econometrics**

Hotel Cleveland — *Joint with Econometric Society*

Chairman: Simon Kuznets, University of Pennsylvania

Papers

Intertemporal Comparisons of Real National Income, an International Survey
J. B. D. Derksen, Statistical Office, United Nations

Index Numbers of the Elements of the Equation of Exchange
Clark Warburton, Federal Deposit Insurance Corporation

4-6 P. M. — **Bioassay**

Ohio Room — *Biometrics Section joint with Biometric Society and Institute of Mathematical Statistics*

Chairman. H. C. Fryer, Kansas State College

Papers

Evaluation of Field Insecticides from Count of Survivors
Chester I. Bliss, Connecticut Agricultural Experiment Station

Curved Dosage—Response Curves
Oscar Kempthorne, Statistical Laboratory, Iowa State College

Tolerance Limits for Pharmaceutical Preparations
M. W. Greene, American Pharmaceutical Association

A Practical Method for Determining the Mean and Standard Deviation of Truncated Normal Distributions
J. Ipsen, Yale University

Discussion — D. B. DeLury, University of Toronto

TUESDAY

4-6 P. M. — **Presentation of Data**

Euclid Room — *Committee on Graphic Presentation*

Chairman: K. W. Haemer, American Telephone and Telegraph Company

4-6 P. M. — **Special Topics**

Pine Room — *Chairman:* Lester S. Kellogg, Deere and Company

Papers

Sociograms
Leon Festinger, University of Michigan

Critical Appraisal of the Bureau of Agricultural Economics
Raymond Jessen, Statistical Laboratory, Iowa State College

Statistical Methods in the Weighing of Imported Merchandise
John J. Williams and Louis Tanner, U. S. Customs Bureau

A Reconsideration of the Meaning of Index Numbers
Melville Ulmer U. S. Department of Commerce

The Logic of Scales
Louis Guttman, Cornell University

8-10 P. M. — **Annual Business Meeting**

Grand Ballroom — *Chairman:* George W. Snedecor, Statistical Laboratory, Iowa State College

WEDNESDAY—DECEMBER 29, 1948

10 A.M.-NOON — **Special Feature**

Euclid Room — *Chairman:* Helen M. Walker, Columbia University

Papers

Statistics of the Kinsey Report
(To Be Announced)

10 A. M.-NOON — **Input-Output Analysis and its Use in Peace and War Economics**

Ohio Room — *Joint with American Economic Association*

Chairman: Morris A. Copeland, Federal Reserve Board

Papers

Recent Development of Techniques
Wassily Leontieff, Harvard University

Evaluation of Applicability of Techniques
(To Be Announced)

Discussion

Marvin Hoffenberg, Bureau of Labor Statistics—Milton Gilbert, Department of Commerce—Tjalling C. Koopmans, Cowles Commisison for Research in Economics, University of Chicago.

10 A. M.-NOON — **Agricultural Statistics I—Measurement of Main Economic Magnitudes**

Pine Room — *Joint with American Farm Economic Association*

Chairman: William G. Murray, Iowa State College

Papers

Measurement of Agricultural Production
Charles F. Sarle, Bureau of Agricultural Economics

Estimates of Agricultural Employment and Wage Rates
Thomas C. M. Robinson, Bureau of Agricultural Economics

Discussion

Clifford G. Hildreth, Iowa State College—Gladys L. Palmer, University of Pennsylvania

10 A. M.-NOON

Contributed Papers in Biometrics

Parlor 3

Biometrics Section joint with Biometric Society

NOON-4 P. M.

Business Outlook for 1949

Luncheon
Grand Ballroom

Chairman: Emanuel A. Goldenweiser, The Institute for Advanced Study

Speakers

Frank D. Newbury, Westinghouse Electric Corporation
Donald B. Woodward, Mutual Life Insurance Company
Russell Weisman, Western Reserve University

2-4 P. M.

Recent Developments in Sampling Methodology

Euclid Room

Chairman: William G. Cochran, Johns Hopkins University

Papers

Time and Cost Analysis in Relation to Sample Design
Raymond J. Jessen, Statistical Laboratory, Iowa State College

The Use of Controls Beyond Simple Stratification in the Probability Selection of a Sample
Roe Goodman and Leslie Kish, Survey Research Center, University of Michigan

Discussion

Earl E. Houseman, Bureau of Agricultural Economics—Lester R. Frankel, Dun & Bradstreet, Inc.

2-4 P. M.

Agricultural Statistics II—Measurement of Main Economic Magnitudes

Pine Room

Joint with American Farm Economic Association

Chairman: Elmer J. Working, University of Illinois

Papers

Estimates of Prices Received and Prices Paid
George M. Kuznets, University of California

Measurement of Farm Income and Expenditure
E. W. Grove, Bureau of Agricultural Economics

Discussion

B. R. Stauber, Bureau of Agricultural Economics—D. Gale Johnson, University of Chicago

2-4 P. M.

Effects of Errors in the Independent Variate in Regression Problems

Parlor 3

Biometrics Section joint with Biometric Society and Institute of Mathematical Statistics

Chairman: Carl F. Kossack, Purdue University

2-4 P. M.

Contributed Papers in Mathematical Statistics

Ohio Room

Joint with Institute of Mathematical Statistics

WEDNESDAY

4-6 P. M. — **Needs for Agricultural Statistics not now Available**

Pine Room — *Chairman:* Charles F. Sarle, Bureau of Agricultural Economics

Papers

Agricultural Statistics Needed by Farmers
H. Stanley Nicol, Iowa Farm Bureau Federation

Agricultural Statistics Needed in Market Analysis Research
Victor Hawkins, Capper Publications, Inc.

How Some of the Needs of Agricultural Statistics Can be Met by Sampling
Charles F. Sarle, Bureau of Agricultural Economics

4-6 P. M. — **Special Topics**

Euclid Room — *Chairman:* A. F. Hinrichs, Economic Cooperation Administration

Papers

Union Records as Statistical Sources
Albert Epstein, International Association of Machinists

The 1950 Housing Census
Howard G. Brunsman, Bureau of the Census

Western Hemisphere Census of 1950
Calvert L. Dedrick, Bureau of the Census

Power Cost Comparison for Atomic and Conventional Steam Stations
Walter Isard, American University, and John Lansing, Massachusetts Institute of Technology

Some Problems and Methods of Measuring the World Economy
William R. Leonard, Statistical Office, United Nations

Statistical Problems in Germany
Horst Mendershausen, Bennington College

4-6 P. M. — **Symposium on Randomness and Its Testing**

Ohio Room — *Joint with Institute of Mathematical Statistics*

Chairman: Walter A. Shewhart, Bell Telephone Laboratories

Papers

Survey of Available Tests for Randomness
W. Allen Wallis, University of Chicago

Power Functions of Tests for Randomness
H. B. Mann, Ohio State University

Power Functions of Non-Parametric Tests
Ransom Whitney, Ohio State University

Paul S. Olmstead, Bell Telephone Laboratories—E. J. G. Pitman, University of Tasmania

4-6 P. M. — **Biometrics Section—Business Meeting**

Parlor 3 — *Chairman:* Joseph Berkson, Mayo Clinic

6-8 P. M. — **Meeting of the Council**

Dinner Parlor C — *Chairman:* President for 1949

THURSDAY—DECEMBER 30, 1948

The Eastern North American Region of The Biometric Society will hold its annual business meeting at 9:00 A.M., Thursday morning.

The Institute of Mathematical Statistics will hear invited addresses by T. W. Anderson and E. L. Lehmann in a session from 10:00-12:00 A.M., Thursday morning.

Women in Statistics CONTINUED FROM PAGE 17

the members of the American Statistical Association and their 14 per cent ratio among the 1944 National Roster registrants in statistics. Generally speaking, the demand for statisticians has been less differentiated on the basis of sex as compared with the demand in many older occupations. The nature of the work as well as the continuing shortage of trained statisticians have been given as reasons for the less evident discrimination against women in this field of work.

A shortage in supply caused by lack of training facilities and failure to emphasize statistical preparation has aggravated the shortage in the face of a growing demand. The shortages in turn may be responsible for the somewhat higher salaries received by statisticians at the Ph.D. level as compared with mathematicians at the same level. Only about 50 Ph.D.'s in mathematical statistics had been awarded up to 1946 according to the National Research Council's Committee on Applied Mathematical Statistics which reported that only 10 colleges and universities had programs in mathematical statistics adequate for the training of Ph.D.'s. There is likely to be, for some time, therefore, a dearth of leadership in this expanding field. Less serious shortages appear all down the ranks.

The outlook for women in statistics, therefore, the Women's Bureau concludes, is favorable for the next few years at least. There will be increasing opportunity for women thoroughly grounded in statistics at the undergraduate level, and even more opportunity for the few who obtain the Ph.D.

NEWS CONTINUED FROM PAGE 5

BLS new weekly index of wholesale prices

The Bureau of Labor Statistics has announced the development of a weekly abbreviated wholesale price index to replace the weekly comprehensive index which has been issued since 1932. The new series will be issued every Friday, covering the 7-day period ended the preceding Tuesday. Separate indexes will be provided for "all commodities," "all commodities other than farm products and foods," 6 major groups separately, and the 4 other groups combined. The sample does not provide sufficient coverage for the computation of reliable subgroup indexes; however, if there is considerable demand for subgroup indexes, the Bureau may develop separate samples to provide weekly indexes for the more important subgroups.

The new index, based on a sample of 115 commodities drawn from the nearly 900 included in the monthly comprehensive index, will be directly comparable to the monthly index; the present weekly comprehensive index has not been directly comparable to the monthly series.

Sources of farm statistics listed

A complete list of the economic and statistical publications of the Bureau of Agricultural Economics of the U. S. Department of Agriculture is given in a new publication of the bureau, "Agricultural Economic and Statistical Publications." The sources are described and the contents summarized. Besides listing all the periodicals and scheduled reports of BAE, it lists all the economic and statistical publications the bureau now has available. The bureau's organization is outlined and names and addresses of heads of divisions and field offices are given. Copies may be requested from the Division of Economic Information, BAE, USDA, Wash. 25, D. C.

N. B. E. R. Income and Wealth report

The National Bureau of Economic Research Inc. has just published the first issue of the annotated quarterly report of the International Bibliography on Income and Wealth. The report was prepared by the secretariat of the International Association for Research in Income and Wealth, and a limited number of copies is available for distribution to university libraries and scholars working in these fields. Requests should be addressed to the Association in care of the National Bureau of Economic Research, Inc., 1819 Broadway, New York 23, N.Y.

Index of 1947 ATSM standards

The American Society for Testing Materials published in May 1948 an index to their 1946 Book of Standards and its 1947 supplements. The new index makes it possible to locate readily any of the 1500 standard specifications and tests listed. Copies of the 240-page publication are furnished without charge on written request to ASTM headquarters, 1916 Race Street, Philadelphia 3, Pa.

Guide to 1947 Census Publications

The Bureau of the Census has issued "Census Publications, 1947, Catalog and Subject Guide, the second of an annual series listing the publications of the Bureau for the calendar year and providing a subject-matter index to their contents. As a special appendix, the 1947 volume also includes an index to "Publications of the 1945 Census of Agriculture." This appendix includes an annotated listing of all final reports of that census, and a subject index, presented in tabular form, showing where information on each subject appears in each of the reports. This index is also available as a separate reprint.

The 1947 Catalog and Subject Guide is now available from the Government Priting Office at $1 a copy.

QUESTIONS and ANSWERS

edited by FREDERICK MOSTELLER
Harvard University

COMBINING INDEPENDENT TESTS OF SIGNIFICANCE

Question 14. I have made several tests of significance on independent data. The tests I have made concern the difference between mean scores under two different treatments. Retaining the same order of differencing in the numerator of my t-test, I get t values of $-.68$, $+1.53$, $+2.21$, $+1.85$ with 6, 18, 22, and 25 degrees of freedom respectively. I would like to make a combined test of significance to test whether the difference between the means is positive. I do not want to try to form a single value of t from the original raw data for various experimental reasons. In *Statistical Methods for Research Workers* R. A. Fisher presents a method of combining tests of significance, but it seems not to apply to the present situation since one of my differences is in the wrong direction. Also I fail to see how Fisher's method takes account of the varying degrees of freedom in the four sets of data. Can you tell me an appropriate procedure for combining these data? If you have any other advice about combining independent tests of significance, I would be glad to get it.

Answer. If the test based on the product of probabilities from different trials is adopted, allowance can be made for the occasional occurrence of negative values of t by calculating the corresponding probability for a single tail. Negative values of t will then supply probabilities greater than .5, which do not greatly reduce the product and, since they introduce two additional degrees of freedom, will tend to lower its significance.

Thus with the illustrative values given in the problem, I obtain the following table:

n	t	P(single tail)	$\log_e 1/P$
6	$-.68$	.739	.3025
18	1.53	.0717	2.6353
22	2.21	.01932	3.9466
25	1.85	.03809	3.2698
			10.1542

Doubling the total of the natural logarithms we have chi-square equal to 20.31 for 8 degrees of freedom, corresponding to a probability rather less than 1%. If, as seems here to be the case, consistent deviations in either direction would be deemed relevant, we may say that the probability is less than 2% for the observation of deviations so large and so consistent in direction as those observed.

The differences in the degrees of freedom of the several trials, and also differences in their respective precisions, are, of course, reflected in the values of P to be multiplied together. The inclusion of the first trial lowers the significance of the test, and it may well be that this first trial was on so small a scale that it was likely *a priori* to do so. It would have been open to the experimenter to decide in advance not to conduct any trials with less than 15 degrees of freedom, or, equally legitimately, not to include such trials in his test. Such a decision must, however, be taken in advance and not after inspection of the resùltt of the trials. Generally, therefore, if combination by the producs method is intended, it will be worth while to aim at a succession of trials of approximately equal sensitiveness. More usually, however, the test will be employed to give provisional guidance based on all the evidence to hand, and this will often be of very variable precision.

It may be noticed that the same body of data may give a significant combined test in whichever direction the effect is tested. This would, of course, indicate reality of departure from the null hypothesis, but in discrepant directions in different cases, so that the results of the several trials would be heterogeneous.

R. A. Fisher

SUMMING SERIES

Question 15. I would like to have an accurate approximation for

$$S(x) = \sum_{n=1}^{x} 1/n^t = 1 + 1/2^t + 1/3^t + \ldots + 1/x^t,\ 0 \leq t \leq 1.$$

I have tried to approximate $S(x)$ by integrating, but I find very low accuracy. Can you make any suggestion?

Answer. One good method for summing finite series such as the present one is given by Euler's Summation Formula. In general if

$$S(x) = \sum_{n=1}^{x} f(n),$$

Euler's Summation Formula is given by

$$F(x) = \int_1^x f(n)dn + (1/2)f(x) + (1/2!)B_1 f'(x) - (1/4!) \cdot B_2 f'''(x) + \ldots + \gamma\,(f).$$

In this formula γ is the generalized Euler's constant which needs to be determined for the particular function and parameters involved; the B's are the Bernoulli numbers, $B_1 = 1/6$, $B_2 = 1/30$; and $f'(x)$ and $f'''(x)$ are the first and third derivatives of the function to be summed evaluated at the upper limit x.

For the particular function $f(n) = 1/n^t$ in the proposed series $S(x)$ we have the following formula for the approximation:

$$F(x) = \left.\begin{array}{l} \log x,\ t = 1 \\ \dfrac{x^{1-t} - 1}{1-t},\ 0 \leq t < 1 \end{array}\right\} + 1/2x^t - t/12x^{t+1} + t(t+1)(t+2)/720\ x^{t+3} + \ldots + \gamma\,(t).$$

When $t = 1$ the series $S(x)$ is the harmonic series, the sum of the reciprocals of the integers. This is the particular series with which Euler's Constant is usually associated. For this series $\gamma\,(1) = .57722$, known as Euler's Constant. This number can be easily checked by actually writing down the sum of the reciprocals of say the first 10 integers and comparing this result for $S(x)$ with the calculated value of $F(x)$. It will be found that Euler's Constant is the value of $\gamma\,(1)$ needed to make $F(x)$ agree with $S(x)$ to 5 decimal places.

It now becomes clear that if we are to approximate $S(x)$ by $F(x)$ we need to have values of $\gamma(t)$ for $0 \leq t \leq 1$. When $t = 0$, the result is easy because $S(x)$ is just the sum of x numbers all of which are 1, so $S(x) = x$ for this case. On the other hand, since the derivatives of $f(n)$ all vanish when $t = 0$,

$$F(x) = x - 1 + 1/2 + \gamma(0) = x - 1/2 - \gamma(0).$$

Therefore $\gamma(0)$ is exactly 1/2.

The following table gives $\gamma(t)$ to 5 decimals by intervals of .1 for $0 \leq t \leq 1$. Some of these values may be in error by one in the last place. We see that $\gamma(t)$ is approximately linear, so we suggest as a linear approximation

$$\gamma^*(t) = \gamma(0) + t[\gamma(1) - \gamma(0)] = 1/2 + t(.57722 - 1/2)$$
$$= 1/2 - .07722\,t.$$

Values of $\gamma^*(t)$ are given in the table for comparison with $\gamma(t)$

A quadratic approximation obtained by fitting $kt(1-t)$ to the residuals $\gamma(t) - \gamma^*(t)$ is given by
$\gamma^{**}(t) = \gamma^*(t) + .00415\,t(1-t) = 1/2 + .07722t + .00415\,t(1-t)$
$= 1/2 + .08137t - .00415t^2$.

TABLE I

Table giving values of the generalized Euler constant $\gamma(t)$, a linear approximation $\gamma^*(t)$, and a quadratic approximation $\gamma^{**}(t)$.

t	$\gamma(t)$	$\gamma^*(t)$	$\gamma^{**}(t)$
0.0	.50000	.50000	.50000
0.1	.50808	.50772	.50810
0.2	.51608	.51544	.51611
0.3	.52401	.52317	.52404
0.4	.53187	.53089	.53188
0.5	.53965	.53861	.53965
0.6	.54735	.54633	.54733
0.7	.55495	.55405	.55493
0.8	.56246	.56178	.56244
0.9	.56989	.56950	.56987
1.0	.57722	.57722	.57722

It will be seen from Table I that the linear approximation is off at most 1 unit in the third decimal place, while the second approximation is off at most 3 units in the fifth decimal.

It would perhaps be well to illustrate the accuracy of the approximation $F(x)$ by summing say 9 terms of $1/\sqrt{n}$.

Example: Find $S(9) = \sum_1^9 n^{-1/2}$. Five decimal

place exact values are given by

n	$n^{-1/2}$
1	1.00000
2	.70711
3	.57735
4	.50000
5	.44721
6	.40825
7	.37797
8	.35355
9	.33333
$S(x)$	4.70477

$$F(9) = \frac{9^{1/2} - 1}{1/2} + \frac{1}{2.9^{1/2}} - \frac{1/2}{12\,(9)^{3/2}}$$
$$- \frac{1/2 \cdot 3/2 \cdot 5/2}{720 \cdot 9^{7/3}} + .53965.$$

Adding up the terms we have

4.00000
.16667
.53965
4.70632
−.00154
$F(x) = 4.70478$

This result, one unit off in the fifth decimal place, is better than we could have expected, considering rounding errors in $S(x)$ and $F(x)$ and that $\gamma(1/2)$ may be off one unit. Actually if $\gamma(t)$ had been computed to more decimals we could have had the result correct to 6 or even more places because the term involving the third derivative only contributes one unit in the sixth decimal.

It might be added that $F(x)$ can be used to get sums of positive integral powers of integers exactly. If this is desired all constants are neglected. The constants are neglected because the terms of the sum must always be at least of the first degree in x. Of course, the sum takes a slightly different form from that given or the previous example. If we want

$$S_1(x) = \sum_1^x n^t \quad t = 0, 1, 2, \ldots.$$

$$F_1(x) = x^{1+t}/(1+t) + (1/2)(x)^t + t(x)^{t-1}/12$$
$$- \frac{t(t-1)(t-2)}{720} x^{t-3} + \ldots .$$

This formula will suffice to sum powers of the integers through $t = 5$, but for $t = 6$ and greater we will need more Bernoulli numbers and the terms involving fifth and higher odd derivatives.

Example: Sum the fifth powers of the integers.

$$F_1(x) = x^6/6 + x^5/2 + 5x^4/12 - x^2/12$$
$$= \frac{x^2(x+1)^2(2x^2+2x-1)}{12}.$$

for information about the

108th Annual Meeting of the AMERICAN STATISTICAL ASSOCIATION

December 27-29
Hotel STATLER
Cleveland, Ohio

write to the American Statistical Association, 1603 K St., N. W., Washington 6, D. C.

How to Use A Set of Display Charts

by EDWARD J. HEGARTY

Westinghouse Electric & Manufacturing Company

Not so long ago, I was in a distributor's place to put on a meeting. The janitor was helping me set up my props. When we were finished, he looked over the room and asked, "What, no charts?"

Yes, even a handy man knows that you have to have charts if you're going to present a story to a group.

But what the handy man doesn't know and what so many people who try to use charts don't know is how to get the most out of them. Here are some suggestions:

1. KNOW YOUR CHARTS—Study the charts before hand—not before the audience. Get so familiar with them that a glance will remind you of the story you are to tell about each one.

2. PUT NOTES ON THEM—Recently a man told me, "I can't make a good presentation from these charts." I suggested, "Why not make a penciled note on each of them, reminding you what you're going to say about that chart? You'll be able to see the penciled notes but your audience won't." Such notes will help you tell the parts of your story in the proper order. Match your charts with your story. It is strange how many men will tell a story and then find the chart that calls for that story later in the series.

3. DON'T READ THEM—Nothing is so deadly as the chart presentation where the man reads what is on chart number one, then what is on number two, and so on. Such treatment asks for yawns, and usually gets it. Try telling the story in words different from those on the charts.

4. VARY YOUR INTRODUCTION—Not long ago I heard a man introduce every chart with, "This chart is supposed to show . . ." There is no need for such an introduction. Show the chart and then start talking about the message contained in it.

5. TELL WHAT EACH MEANS—If the chart shows a picture, describe the picture. Tell what it shows and why it is shown. If it is a diagram, explain it. Don't leave the audience to figure it out. No matter how simple the story shown, tell it in your own words: but remember that explaining a chart doesn't mean reading it out loud.

6. GET ENOUGH LIGHT ON THEM—If possible, check up beforehand on the room in which you are going to use the charts. If there is not enough light, get more. Use a spotlight if necessary, but stand so that your shadow does not fall on them.

7. MAKE SURE THEY CAN BE SEEN—Be sure the charts are large enough to be seen by every person in the group. The lettering should be of a size that can be easily read. If you write out the chart as you go along, write plainly and large enough so that all can see. Always place the charts high enough so that people in the front will not block the view.

8. SET UP THE ROOM SO THAT NOBODY IS BEHIND THE CHARTS—Get the entire audience in front of the charts. Make sure nobody is behind them to steal attention from them.

9. KEEP THEM COVERED—If the audience can see all the charts at once, they may get a different story from the one you want them to get. Show the charts one at a time. If you have only one chart, keep it covered until you are ready to use it. Take full advantage of the element of surprise. If you use charts which open like a book, use only one page for the message.

10. PRACTICE USING THEM—I've seen men fumble around setting up their charts, or trying to change from one to another. It will pay every man who has to use a set of charts to practice until he can change them easily.

11. LET THE AUDIENCE HELP—If you can get the audience to help you work with the charts, bring them in. I've seen speakers have a man in the audience read the chart aloud. Then he asked another what the point meant. He increased interest, and also made his points stronger by repetition.

12. THE SIMPLER THE BETTER—In making up the charts, keep them simple. One idea to a page and not too much detail is a good rule. Try to get variety in the subject matter—now a chart, next a diagram, then a tabulation. Such variety helps hold audience attention.

13. DON'T GET IN FRONT OF THEM—Stand beside your charts. Don't get in front of them. You're not transparent. If there are people on the sides of the room, perhaps you'd better stand slightly behind the charts. Don't ever face the charts, face the audience. Get so familiar with them that a glance as you turn over a chart will give you the cue to the story you are to tell.

14. USING FILM CHARTS — In using charts made on lantern slides or sound slide films, stand at the projector where you can see the charts, not up at the screen.

15. USE THEM IN ORDER—Get your charts in order, and present them in that order. Don't tell what's coming in a chart ahead. Don't jump back and forth through them. And for goodness sake don't turn back hunting for a chart you talked about some time ago.

***From an article in* Printers Ink.**

NEWS about MEMBERS

B **Jeffrey Beale,** formerly with the Institute of Paper Chemistry, is now doing research on glass with the Preston Laboratories in Butler, Penn. **Raj Chandra Bose** has resigned as head of the graduate Department of Statistics of the University of Calcutta. He has been appointed Professor of Mathematical Statistics at the University of North Carolina, where he served as visiting Professor of Statistics in the Institute of Statistics during the winter and spring of 1948.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION REQUIRED BY THE ACT OF CONGRESS of AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (39 U. S. C. 233) OF *The American Statistician*, published six times per annum at Washington, D. C., for 12 months ending October 1, 1948.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, American Statistical Association, 1603 K St., N. W., Washington 6, D. C.; Editor, Sylvia Weyl, 1603 K St., N. W., Washington 6, D. C.; Managing editor, Merrill M. Flood, 1603 K St., N. W., Washington 6, D. C.; Business manager, none.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as those of each individual member, must be given.) American Statistical Association, 1603 K St., N. W., Washington 6, D. C.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are not any, so state.) None.

4. The two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MERRILL M. FLOOD, *Managing Editor.*

Sworn to and subsribed before me this 17th day of September, 1948.

NORMAN S. SILL, *Notary Public.*

(My commission expires September 13, 1951.)

Weir M. Brown has resigned from the Division of Research and Statistics, Board of Governors of the Federal Reserve System, to accept a position in the Treasury Department in the European Division of the Office of International Finance. **Gerhard Bry** is now established in New York City as Consulting Economist, specializing in the field of economic and statistical analysis in legal practice.

C **Stanley Clark** has accepted a position as Associate Professor of Education at the College of Education, University of Saskatchewan, Canada. **S. Lee Crump,** formerly Assistant Professor at the Statistical Laboratory, Iowa State College, is now with the Atomic Energy Project at the University of Rochester.

D **Ernst A. Dauer** has been appointed Director of a new department of consumer credit studies, established by the Household Finance Corp. in Chicago. Dr. Dauer had been Principal Economist on the staff of the Federal Deposit Insurance Corp. in charge of research on bank earnings and consumer credit activities for over 10 years. In his new position he will be in charge of research and editorial work and liaison with economists and institutions in the general field of consumer credit. **W. Edwards Deming,** Bureau of the Budget, combined attendance at the session of the United Nations Sub-commission on Statistical Sampling in Geneva with giving seminars in Paris, Rome and Amsterdam on sampling, statistical control of quality, testing and related subjects.

F **Walter T. Federer** has been appointed Professor of Biological Statistics in the Department of Plant Breeding, Cornell University.

G **James P. George** has been appointed Professor of Economics at Baylor University, Waco, Texas.

H **Philip M. Hauser** has been named Associate Dean of the Division of Social Sciences at the University of Chicago. **Walter A. Hendricks,** on army detail from BAE, has helped set up a program of enumerative sampling for the American and British zones of Germany.

J **James M. Jarrett** has been appointed Economic Adviser to the Chairman of the Excess Profits Tax Council, Bureau of Internal Revenue.

K **Louis S. Katz,** formerly Regional Statistician with the Public Housing Administration in New York City, has transferred to the Naval Air Station at Quonset Point, Rhode Island, as Supervisor of the Performance Review Section of the Industrial Management office. **Paul Koenig,** on detail to the army from BAE, is helping to conduct an enumerative sampling program in the American and British zones in Germany. **Tjalling C. Koopmans** has been appointed Professor of Economics at the University of Chicago. He is now the Director of Research of the Cowles Commission for Research in Economics.

L **Max Lehrer** has been appointed as statistician in the Office of the Budget, Office of the Secretary of Defense. **Abraham Libove,** formerly Senior Statistician with the Division of Placement and Unemployment Insurance of the N. Y. State Department of Labor, has been appointed Senior Statistician with the New York State Workmen's Compensation Board. **Eugene Lukacs** has accepted a position as statistician at the U. S. Naval Ordnance Test Station, China Lake, California.

M **Leo Mandel** has accepted a position as sales statistician with the International Vitamin Division of the Ives-Camron Co., Inc., in New York. **W. Parker Mauldin,** formerly with the Department of Medicine and Surgery, Veterans Administration, has joined the staff of the Office of the Statistical Assistant to the Director, Bureau of the Census, as a social science analyst. **Henry Moore,** Director of the Bureau of Business Research of the

University of Colorado, has been elected Chapter Representative to the national office, and has been appointed to serve on the Interim Committee to Plan the Program for the Western Meeting of the American Statistical Association, to be held in 1949. **Judy Moss** is now working as Economic Analyst in the Planning Bureau of the Port of New York Authority.

N **Mary B. Novick,** formerly Administrative Analyst with the U. S. Bureau of the Budget, has been appointed Director of the School of Public Administration at the University of Puerto Rico.

R **Thomas C. M. Robinson,** Division of Special Farm Statistics, BAE, has returned from a special assignment for FAO in Baghdad, Iraq, where he taught a course in agricultural estimating methods at the Agricultural College.

S **Emil Schoenbaum,** Professor, Charles University, Prague, Czechoslovakia, has been appointed by the Mexican government to work for a limited period of time as an adviser for the Mexican Institute of Social Insurance. **Saul B. Sells** is now on the staff of the Department of Psychology of the Air University, School of Aviation Medicine, Randolph Field, Texas. **Louis Shere** has left the Treasury Department to become Professor of Economics and Director of Tax Research in the Department of Economics, Indiana University.

T **Gerhard Tintner** of Iowa State College will spend the next year in Cambridge at the Department of Applied Economics. He also expects to give a course of lectures in econometrics during his stay in England. **L. H. C. Tippett,** Chief Statistician of the British Cotton Industry Research Association, delivered twelve lectures on Statistical Quality Control and Industrial Experimentation, May 5-14, at the Massachusetts Institute of Technology. **Ralph W. Tyler** has been appointed Dean of the Division of Social Sciences at the University of Chicago.

CHAPTER NOTES

CLEVELAND

Officers for 1948-1949 are as follows: President — Donald S. Thompson, Vice-President and Economist of the Federal Reserve Bank of Cleveland; Vice-President—David C. Elliot, Economist of the Cleveland Trust Co.; Secretary—Gale R. Ober, Jr., Statistician with Howard Whipple Green & Associates.

DENVER

Officers of the Chapter elected for 1948-1949 are: President—Earl T. Gilbert, Supervising Statistician, Mountain States Telephone and Telegraph Co.; 1st Vice-President—Harold L. Davis, Business Economist, U. S. Bureau of Reclamation; 2nd Vice-President — Clare Shove, Educational Consultant, F. E. Compton and Co.; Secretary-Treasurer—Margaret Brittan, Research Analyst, University of Denver Bureau of Business and Social Research.

Programs: Fall, 1948, Olin Hotel, Denver
Sept. 16 Subject: Traffic Engineering for Denver; Mr. Henry A. Barnes, City Traffic Engineer.
Oct. 14 Subject: Statistics in Public Health; Dr. Florence Sabin.
Nov. 11 Subject: Training for and Opportunities in Statistics.
Dec. 9 Subject: Personnel Research at Gates; Mr. Fred Oberlander, Director of Personnel Research, Gates Rubber Co.

NEW YORK

NEW YORK CHAPTER ORGANIZES PLACEMENT COMMITTEE

In an effort to perform additional services for local members and also be of help to business organizations in the area, the New York Chapter organized the Placement Committee. The broad functions of this committee are to help members in finding jobs and to assist prospective employers in getting the services of qualified statisticians.

The chairman, Frank Lang, recently announced the workings of this employment machinery. The committee is divided into ten fields of specialization, each headed by a Coordinator, a person well qualified to guide and counsel prospective employees on job opportunities in the field.

The group will work through existing employment agencies, both public and private, and will cooperate with similar committees in other professional societies.

It is pointed out, of course, that the committee cannot recommend or guarantee qualifications of any applicant. They merely clear jobs and applicants while the New York State Employment Service screens them.

In the metropolitan area, members looking for jobs and jobs looking for members are advised to start by getting in touch with Frank Lang, Association of Casualty & Surety Companies, 60 Jay Street, New York 7, N.Y.

CHICAGO

Dr. George W. Snedecor, National President of the American Statistical Association, was the speaker at the first regular meeting of the Chapter.

This year in addition to the regular dinner meeting the chapter will conduct two series of monthly luncheon meetings. One series, on Statistical Techniques, will meet on Tuesdays, starting October 12. The other series, on Statistical Applications, will meet on Tursdays, starting October 28. Both luncheon groups will meet at 12 noon at Marshall Field Company's English Room.

The Government Statisticians group will continue its activities this year with five afternoon meetings, a luncheon meeting and sponsorship of one chapter dinner meeting.